Validation of the SBT (Safety Behaviour Test):
The Impact of Individual Characteristics on SBT Use and Performance

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Abstract

Given the proportionately high number of work related accidents that occur in New Zealand each year, hiring employees that demonstrate safety behaviour is of the utmost importance to organisations. Despite the importance of having safely behaving employees, methods of assessing safety behaviour are currently limited to self report and accident history analysis, which are associated with self report bias. To address the demand for an alternative method, the Safety Behaviour Test (SBT) was developed. The SBT is a gamified assessment, in which users interact with a game environment that tests their safety behaviour based on a number of decision points. The aim of the current investigation was to determine whether the individual characteristics of a person have an identifiable impact on SBT use and performance, thus it was an investigation of *adverse impact*. In order to achieve this aim, 100 participants completed the SBT and a questionnaire regarding their individual characteristics, and the scores of both assessments were correlated. Of all of the individual characteristics measured in the current investigation, only computer game experience was found to potentially have an adverse impact on SBT performance. Altogether, the results from the current investigation and the results of an associated work on the SBT by Crowe (2018), which investigated the criterion- related validity of the SBT, indicate that the SBT authentically measures safety behaviour. The implications of these findings and the advantages of using gamified assessments are discussed.

Introduction

1.0 Overview

The current study investigated whether a person's individual characteristics have an identifiable impact on their performance on a new measure of safety behaviour – the SBT. The study was conducted in conjunction with another study that investigated the criterion related validity of the measure (Crowe, 2018). While both the current investigation and the work by Crowe (2018) used the SBT data, each study predominately used separate questionnaires, as will be discussed in the method section. The introduction begins by discussing the health and safety context in New Zealand, and considers the idea that the high proportion of work place accidents observed may be the result of low safety behaviour in employees. Methods of measuring safety behaviour during selection procedures for the purpose of increasing the prevalence of employees that behave safely are then considered, with the major pitfalls of these measures discussed. Specifically, measurement of a job applicant's safety behaviour is currently restricted to self report and accident history analysis, which are vulnerable to social desirability biases. The demand for an alternative method of assessing safety behaviour through gamification is highlighted, as this method would allow safety behaviour to be assessed through actual behaviour rather than self report, and would in turn provide organisations with a more valid selection tool. For this reason, the safety behaviour test (SBT) was developed. The SBT is a gamified assessment, in which users interact with a game environment that tests their safety behaviour based on a number of decision points. As with any new measurement tool, it is important to determine whether or not it is able to measure what it was intended to measure. Furthermore, it is important to ensure that the measure has no adverse impact on any group of people, thus giving rise to the current investigation.

1.1 International and New Zealand Work Place Accident Statistics

According to the International Labour Organisation (2017), one person dies every 15 seconds as a result of a work related accident or disease, while another 153 people experience a non-fatal work related accident. This means that 5,760 people die every day from a work place accident or disease, adding up to 2.1 million deaths each year. Furthermore, it means 3.2 million non-fatal work related accidents occur each year. While these statistics are alarming, it is even more distressing to learn that a high proportion of these accidents occur in New Zealand.

In a study comparing statistics from Australia, Canada, Finland, France, Norway, Spain, Sweden, United Kingdom, and New Zealand, it was observed that New Zealand had the greatest number of occupational fatal injuries between 2005 and 2008 (Lilley, Samaranayaka, & Weiss, 2013). This trend remained true even once the data had been standardised to control for New Zealand having a greater amount of high risk occupations compared to the other countries. In regard to the number of accidents that occur in New Zealand each year, Worksafe New Zealand (2017a) reported 57 work related fatalities for the year 2013. Additionally, Statistics New Zealand (2016) found that 110 injury claims were made for every 1000 full time employees in 2015. The amount of work related accidents revealed in these figures has serious economic and social consequences for the country.

In terms of the economic cost associated with work related accidents, the International Labour Organisation (2017) estimates that poor occupational health and safety practices are equivalent to 4% of the global gross domestic product every year. In New Zealand, the 2014/2015 Accident Compensation Corporation Annual Report revealed that there had been 1.8 million claims, which accumulatively cost $3.2 billion (Accident Compensation Corporation, 2016).What is more concerning, however, is that these figures do not take into account associated costs of work related accidents such as that of rehabilitation, retraining, damage to equipment and infrastructure, and recruitment of replacement staff. Furthermore, the impact that work related accidents have outside of the economy is immeasurable.

When considering fatalities in the workforce, the cost goes far beyond that of finances. The loss of a human life has a huge impact on the lives of the person's friends, family and colleagues, with bereavement being associated with many mental and physical health problems such as depression, anxiety, suicidal ideation, and energy loss (Stroebe, Schut, & Stoebe, 2007). While the loss of a loved one is always devastating, it can be even more so when the loss is the result of a work place accident, as it could have been prevented at a number of different organisational levels.

It is informative to look at the nature of the accidents represented by these statistics. For example, almost half of the fatalities that occurred in the agricultural industry were the result of quad bike accidents in 2015 (Worksafe New Zealand, 2017b). While a quad bike accident can be due to a mechanical problem, it is far more likely to be the result of human error, as was found in a review of quad bike accidents conducted by the Ministry of Business, Innovation and Employment (2012). Given the impact of human error on the agricultural industry, and that 43% of the workplace fatalities that occurred in 2015 happened in the agricultural industry (Worksafe New Zealand, 2017c), it is reasonable to believe that human behaviour is responsible for a high proportion of all workplace accidents in New Zealand. In the next section, the factors that can lead to an accident are examined more closely.

1.2 How Do Accidents Occur?

Many models have been developed in order to explain how work related accidents occur. One of the most recognised of these models is Reason's (1990) Swiss Cheese Model, which stipulates that the combination of a number of latent factors and an active failure will result in an accident. Latent factors refer to aspects of the work environment that can allow an accident to occur, including universal factors that will always exist in a given area, and local traps that can be removed or controlled for. These latent factors can be the result of organisational influences, unsafe supervision, or preconditions for unsafe acts, and can therefore be considered to be failures of the system. Additionally, an active failure refers to engaging in unsafe behaviour. If system failures fall into alignment at each of these levels in combination with an active failure, that is if someone behaves unsafely in poor conditions, an accident will occur. However, if system failures align and there is no unsafe behaviour, the potential accident can be avoided. For example a mechanic may create an oil spill on the floor if they are using faulty equipment, however if they are vigilant and avoid slipping on the spill, there will be no accident. In this instance, it is clear to see how the safety behaviour of an individual can determine whether or not an accident occurs.

Ramsey's (1989) Accident Sequence Model also proposes an explanation of accident occurrence, by outlining the sequence of events that occur when a person is exposed to a hazardous situation. In order to avoid the hazard, the person must first perceive the hazard. While perceiving a hazard can be influenced by system components, such as having sufficient lighting in the work place and adequate warning signs around hazards, there is also a behavioural component, in that it requires sensory and perceptual skills of the person exposed to the hazardous situation. Next, the person must be able to understand the hazard. Again, while this understanding can be influenced by any signs or instruction available around the hazard, it also relies on the experience and training of the individual, thereby requiring both system and behavioural components. The final steps in avoiding an accident is for the person to make the decision to avoid the accident, and then have the ability to avoid the accident, which relies solely on the abilities and behaviour of the individual.

In looking at the Swiss Cheese Model, and the Accident Sequence Model, it is evident that there are both system and behavioural factors at play when an individual interacts with a hazard. However, given that an accident can be avoided when system failures are met with safe behaviour, one might conclude that avoiding an accident relies more heavily on the safety behaviour of the individual as opposed to the safety of the systems in place. This idea is supported by the research of Ford and Wiggins (2012), who found that those work sites that require employees to have higher cognitive ability and skills have lower injury rates than those work sites with lower cognitive ability and skill requirements, even when controlling for the number of hazards in those work sites.

In another attempt to explain the occurrence of work place accidents and injuries, Christian, Bradley, Wallace, and Burke (2009) conducted a meta-analysis of peer reviewed articles that investigated antecedents of occupational safety behaviour and safety outcomes. Safety behaviour was defined as the actions that employees use to protect the safety of themselves and those around them (Burke, Sarpy, Tesluk, & Smith-Crowe, 2002), while safety outcomes were defined as tangible safety related events such as accidents, injuries, and fatalities. Additionally, it was determined that safety behaviour is comprised of the constructs of safety compliance and safety participation. Finally, the researchers found that safety knowledge and safety motivation were most strongly related to safety behaviour, as a person must both understand how to be safe and want to be safe in order to behave safely. Given these findings, and those findings regarding the role of safety behaviour in accident occurrence, perhaps it is safety behaviour that should be focused on by researchers and practitioners in order to reduce the high rate of work place accidents in New Zealand. As safety behaviour was found to be comprised of safety compliance and participation, much of the research conducted on safety behaviour focuses on these constructs, as such will be examined in more detail in the following section.

1.3 Safety Compliance and Participation

Safety compliance refers to the completion of work in a safe way, by adhering to work place safety regulations (Neal, Griffin, & Hart, 2000). For example, an employee complying with safety procedures would use all mandated protective wear. Conversely, safety participation describes safety behaviour that is voluntary and goes beyond mandated procedures, such as voicing hazards in the work place to colleagues or supervisors (Neal et al., 2000). These constructs are two separate components of safety behaviour, and determine how safely an individual behaves in their working environment (Griffin & Neal, 2000). Interestingly, the safety compliance and participation of employees has been found to contribute to the safety climate of an organisation, which in turn has a positive impact on safety outcomes.

James and James (1989) defines a psychological climate as a person's perception of their environment. When shared by members of an organisation, this psychological climate becomes an organisational climate. An organisational safety climate, therefore, refers to perceptions of the value of safety held by employees regarding their organisation (Neal & Griffin, 2006). In an investigation of organisational safety climate, Neal, Griffin and Hart (2000) found that safety climate is significantly related to the safety compliance and participation of employees. This finding is not surprising, as it is perceptions of the importance of safety that form foundation of safety climate (Griffin & Neal, 2000), and naturally, employees that deem safety to be valuable are more likely to exhibit safety compliance and participation. There is no organisational climate without people in that organisation; therefore having employees that behave safely will create a positive organisational safety climate.

Organisational safety climate has been found to have a significant relationship with safety outcomes, where a positive safety climate is associated with lower work place accident rates (Seo, Torabi, Blair, & Ellis, 2004). Furthermore, this relationship is observed in a wide range of industries, from restaurants (Barling, Loughin, & Kelloway, 2002) to construction sites (Gillen, Baltz, Gassel, Kirch, Vaccaro, 2002). There are a number of ways in which having a positive organisational safety climate reduces work place accident rates. Firstly, organisational safety climate influences the safety motivation of employees (Zohar, 2000; Neal et al., 2000; Griffin & Neal, 2000). That is, employees that detect a positive organisational safety climate will be informed that safe behaviour is valued in the work place, and will in turn be more likely to demonstrate safe behaviour in order to assimilate. Secondly, having a positive organisational safety climate will indicate to employees that their colleagues care about the wellbeing of organisational members, and will likely cause those employees to reciprocate that care with safety behaviour of their own (Hofmann & Morgeson, 1999).

Given the impact that safety climate has on safety outcomes, organisations should aim to create and foster a positive organisational safety climate. As safety compliance and participation have been shown to form the basis of organisational safety climate (Neal et al., 2000), these constructs provide a means of managing safety outcomes. Safety climate is a shared perception of the value of safety; therefore any employees that exhibit low safety compliance and participation will threaten a positive organisational safety climate and, in turn, increase the likelihood of work place accidents. For this reason, organisations should endeavour to maximise safety compliance and participation in their employees.

One method that organisations could use to increase safety compliance and participation in their employees is to implement health and safety training. Health and safety training has been found to be an effective tool in improving the safety attitudes of employees, assuming it meets a number of criteria (Harvey, Bolam, Gregory, & Erdos, 2001). For example, training should include an element of hazard recognition, as researchers have found people to be more safety compliant when they perceive danger to exist (Vredenburgh & Cohen, 1995). This finding is supported by Ramsey's (1989) Accident Sequence Model, in which hazard recognition is the first step in avoiding an accident. Additionally, training should occur before new employees enter the job, so to address the high accident rate among new employees (Burt, 2015a). In this event, employees would need to meet an assessment standard before they begin working in the organisation.

Despite the above findings that health and safety training can improve safety attitudes, many researchers and practitioners have found that training is not always beneficial (Clemes, Haslam, & Haslam, 2009; Bell, & Grushecky, 2006; Laberge, MacEachen, & Calvet, 2014). Specifically, researchers have observed that while training can appear effective at the time, the knowledge gained by employees is not often applied to the work environment (Carlton, 1987; Clemes et al., 2009). In a review of health and safety training research, Ricci et al., (2016) found strong support for a positive effect of training on attitudes and beliefs, but far less support for a positive effect of training on behaviour. Furthermore, ineffective training can have a detrimental effect on workplace safety, as existing employees that have trust in the training programs at their organisations will also have trust that their new employees will behave safely, and will in turn perceive the risk associated with those new employees to be low (Burt, 2015a). With these beliefs, existing employees will be less likely to support new employees in adjusting to their new role, thereby increasing their risk (Burt & Stevenson, 2009; Burt, Chmiel, & Hayes, 2009; Burt & Hislop, 2013). In light of these downfalls in relying on health and safety training to increase the safety behaviour of their employees, perhaps organisations would find more success in incorporating an assessment of safety behaviour into their recruitment and selection procedures. By assessing the safety behaviour of their job applicants, organisations would be able to ensure that their new employees behave safely before they begin working. The next section examines tools that are currently being used to assess safety behaviour during recruitment and selection.

1.4 Assessing Applicants

There are a number of opportunities within a selection procedure for organisations to measure safety behaviour. Firstly, organisations may choose to examine these competencies in an application blank at the beginning of the selection procedure. An application blank can be used to measure knowledge and skills that are essential for the job, as well as any job experience the applicant may have. This method takes a competency based approach, whereby only job related competencies are measured (Wood & Payne, 1998). Furthermore, the application blank can act as a hurdle, meaning that applicants who do not have the required competencies will be rejected at this stage, while others will continue to the next stage of the selection procedure. Given these aspects of an application blank, if safety behaviour was successfully measured at this point, organisations should be able to ensure that only people who behave safely remain in the applicant pool and continue to the next stage of the selection procedure. Unfortunately, as will be discussed, it is not so easy to successfully measure safety behaviour.

Conversely, safety behaviour can be investigated in an interview. Using an interview procedure to hire new employees is common in organisations. This popularity is likely because structured interviews are widely known to increase criterion related validity, meaning they are effective at revealing applicants that will perform the job to a certain standard (Schmidt & Hunter, 1998; Levashina, Hartwell, Morgenson, & Campion, 2014; Huffcutt, 2011; Barclay, 2001). In turn, by including questions related to safety behaviour in this stage of the selection procedure, organisations should be able to get an insight into how safely applicants would behave on the job, and can choose to either hire or reject those individuals based on that information. However, measuring safety behaviour is not so easily achieved, as will be discussed.

There are also a number of psychometric tools available for organisations to use for measuring safety attributes in the selection procedure, as shown in Table 1. Barrett (2010) provided a review of these measures, identifying 15 different commercial products. For example, the OPRA Consulting Group provides the Health and Safety Indicator (HSI) which assesses a variety of abilities and personal characteristics that relate to safety behaviour (OPRAGroup, 2017). Specifically, the HSI is said to measure attention to detail, understanding of instruction, safety motivation, safety diligence, adherence to rules, openness to guidance, safety confidence, and safety composure. These qualities measured by the HSI are done so using self report, whereby the person being assessed reports on their level of each of the qualities mentioned above. Results from these assessments are then used to determine the risk level of each applicant in regard to their safety ability, which can inform decisions made in the selection procedure. Similarity, SHL Group Limited provides the Workplace Safety Solution Test, which measures the propensity of a person to use safety behaviour in the work place (SHL, 2012). In this instance, safety behaviour is measured using situational judgement and personality testing, again utilising self report methods. Just like the HSI and the Work Place Safety Solution Test, the remaining 13 psychometric tools reviewed by Barrett (2010), shown in Table 1, rely predominantly on self report.

Table 1.

Currently available measures of safety attributes, adapted from Barrett's (2010) review of commercial products associated with the psychological assessment of safety attributes within prospective employees.

Publisher	Product
Bay State Psychological Associates Inc.	Employee Reliability Inventory
Hogan Assessment Systems Inc.	Hogan Safe System
IPAT Inc.	Personnel Reaction Blank
OneTest Pty Ltd.	Onetest Work Safety Assessment (OWSA)
Orion System Inc.	Orion Pre Employment System PE3-SAFE
Psyfactors Pty Ltd.	Situational Safety Awareness Test
Psych Press	Work Safety Assessment
Psychological Consulting Ltd. (PCL)	Risk Type Compass
Psytech International Ltd.	Work Attitude Inventory (WAI)
RightPeople	RMP Safety Inventory
SHL Plc.	Workplace Safety Solution Test
Synergy Safety Systems	Safety Attitude Survey
Vangent (Pearson) Inc.	Employee Safety Inventory (ESI)
Vangent (Pearson) Inc.	Personnel Selection Inventory (PSI)
OPRA Consulting Group	Health and Safety Indicator (HSI)

While there is clearly a range of tools and methods that organisations can use to measure the safety behaviour of their job applicants, they all share a major weakness. Specifically, as mentioned, all of the measures of safety behaviour that are currently available to organisations rely on self report. Self report is commonly used in personality testing, in

GMA type measures, and in simply asking direct questions of a person. In each of these instances, a person is required to respond to questions about their own opinions, characteristics, or behaviour, which can be problematic for a number of reasons. Firstly, self reporting often requires a person to consider how they would behave in a given situation. While a person may try to answer honestly to this type of question, there is no guarantee that their response reflects how they would really behave in those circumstances as it is very difficult to anticipate one's own behaviour, particularly if the given scenario is one that is entirely unfamiliar. Secondly, when asking participants to self report, it can be obvious what is being measured, which makes their response highly susceptible to the social desirability bias.

The social desirability bias refers to a phenomenon where participants over report well liked opinions and behaviour while under reporting those that are unfavourable, and is most common when the subject matter under investigation is considered to be sensitive by the respondent (Krumpal, 2013). Sensitive subject matters are defined as those where there are potential costs or risks to the respondent for responding in a particular way, or to the collective population that the outcome of the question represents (Sieber & Stanely, 1988). The risk or cost to the respondent may include a variety of outcomes, including guilt, shame, humiliation, discovery, or sanction, (Lee & Renzetti, 1990). In the case of selection procedures, applicants are likely to engage in socially desirable responding, as they are at risk of not being hired for the job. Therefore, applicants may indicate that they behave more safely than they really do, thereby deeming their response invalid. Another bias that is known to plague self report measures is that of impression management, where people consciously manipulate their responses in order to present themselves in a particular way (Krumpal, 2013). This bias is driven by the characteristic that many people possess of needing to gain social approval (Leary & Kowalski, 1990). Job applicants are likely to engage in impression management so to present themselves as a safely behaving person, which is a more positive attribute than to be an unsafely behaving person.

Social desirability and impression management can impact all kinds of self report. For example, in using scales, a person engaging in socially desirable responding or impression management may rate themselves more favourably than if they were responding in a non-biased way. Similarly, when being asked direct questions, a person may simply respond in an entirely incorrect way. Finally in regard to personality testing, a person engaging in socially desirable responding or impression management is likely to spend more time responding to sensitive subject matters than if they were responding in a non-biased way, as they may change or modify their answers to appear a certain way (Holtgraves, 2004; Johnson & Fendrich, 2002; DuBrin, 2010). As personality testing reveals information about the inherent qualities of a person, arguably all of the questions could be considered sensitive subject matters, and may therefore be associated with biased results.

Another method used to assess the safety behaviour of job applicants is to look at previous accident history, however this method can also be problematic. Firstly, some applicants may not have had a job before, for example if they are a school leaver, and will therefore not have an employment or accident history to assess. These people will however still vary in their safety behaviour, and should therefore still be assessed in some way. Secondly, the number of work place accidents reported and recorded does not necessarily represent the number of work place accidents that occurred, as some accidents may have gone unreported by the individual. This idea is supported by the research of Sato and Kawahara (2011), who found that accidents in the workplace are immensely underreported. Thirdly, asking a person to recall their accident history relies very heavily on their ability to remember past events. Even if a person is trying to be entirely honest in recalling their past, they may omit information simply due to forgetting it. Fourthly, experiencing accidents may in fact increase a person's safety behaviour, as they may become more cautious and aware of hazards after experiencing the consequences of accident. This idea is supported by the work of Laughery and Vabel (1989) as well as Koubenan (2002) who both found accident experience to correlate positively with safety behaviour. Finally, accident histories can still be affected by self report biases, as they may have been reported by an individual who wanted to play down the severity of what had occurred, or hide occurrence altogether. Together, these ideas suggest that accident history analysis may not give a true indication of the safety behaviour of the individual being assessed.

A numbers of scales that measure various safety related competencies are also commonly used by organisations, including Neal and Griffin's (2006) validated scale of safety climate, motivation, and behaviour, where safety behaviour is made up of safety compliance and participation. Three items in the scale measure safety compliance, while three items measure safety participation. Examples of items include "I use all the necessary safety equipment to do my job", and "I promote the safety program within the organisation" for safety compliance and participation respectively. Although scales such as this were designed with the purpose of being research tools, they are often used in selection procedures to assess applicants. While the use of these scales in selection procedures may not be valid as a result of self report biases, that is not to say that the scales themselves are not valid. Using self report scales in a research setting as opposed to a selection setting is less likely to be associated with any self report biases, as participants will not have anything to gain or lose from responding in any particular way. Additionally, if the research being conducted is anonymous or confidential, as most research is, any response that a participant gives cannot be connected to the participant themselves. Both of these aspects of research will increase the likelihood that the participants will respond honestly.

Given that self report data used in selection procedures is associated with the biases discussed above, it is unlikely that the tools already available for measuring safety behaviour, or the methods used within the selection procedure including the application blank and interview process, will be able to accurately predict safety behaviour. For this reason, there is a clear demand for a new measure of safety behaviour that is not vulnerable to self report biases. An ideal way to assess safety behaviour would be to use a work sample approach where the job applicant can demonstrate their behaviour on the job. Work samples have been consistently regarded as one of the most accurate and valid measures in predicting performance (Hunter & Hunter, 1984; Reilly & Warech, 1993; Roth et al. 2005). However, there are clear ethical reasons why job applicants cannot be placed into a risky situation to measure how they will respond. A way to avoid this ethical issue is to use a simulation, which would provide a measurement of safety behaviour that is not so obvious to those being measured, and allows the measurement of actual safety behaviour instead of predicted safety behaviour. As such, the current investigation reports on the development of a measure of safety behaviour that uses a work simulation developed using a gamification paradigm.

1.5 Gamification and the SBT

Gamification is defined as “the use of game design elements in non-game contexts”, and is predominantly used to make real world activities more engaging (Deterding, Dixon, Khaled, & Nacke, 2011). There are many different types of game design elements, such as leader boards, badges, achievements, ranks, scores, and narratives. It is these elements that are said to make gamified activities fun and addictive to players (Shronfeld, 2010). While only emerging as a common term in 2010, gamification has quickly become a global trend, being used in many different fields for a range of purposes (Zicherman & Cunningham, 2011; Google Trends, 2017). For example, gamification has been applied to e-banking in order to make the online banking experience more fun and attractive, thereby increasing online banking and reducing the demand of face-to-face banking (Rodrigues, Costa & Oliveira, 2016). In addition, gamification is rapidly growing in education, with many users finding that adding gaming components to learning increases motivation and engagement for students (Chen, Burton, Mihaela, &Whittinghill, 2015).

Gamification is also commonly used in organisational settings. Across a range of different industries, work places have found success in applying gamification to a number of different initiatives, such as training, wellbeing activities, employee feedback, marking sales, product design, and research and innovation (Singh, 2012). For example, the call centre Live Ops adopted a system of points, incentives, badges, and leader boards as a way to train their staff, as well as to increase customer satisfaction and teach their staff appropriate call durations (Borque, 2012). It was revealed that the staff that took part in the system outperformed the staff that did not take part in the system by 23%, and customer satisfaction increased by 9%. Furthermore, the amount of time it took to train staff reduced dramatically.

The popularity of gamification in the work place is likely due to the positive impact it has been shown to have on engagement and motivation, which are both associated with increased performance (Gagne & Deci, 2005; Harter, Schmidt, Agrawal, & Plowman, 2013). Furthermore, the success of gamification in the work place has become attractive to prospective employees, with one study finding that as many as 83% of working residents in America were interested in working in an organisation that implements gamification (Saatchi & Saatchi, 2011). Given these accolades, it is no wonder that gamification is rapidly becoming more prevalent in organisations (Singh, 2012).

Organisations have also started applying gamification to their selection procedures. Specifically, organisations including Deloitte and IKEA are applying gaming aspects to their

IQ and personality tests in order to increase engagement with the tests, and to market their organisation to applicants as a fun work place (Chamorro-Premuzic, 2015). Furthermore, gamification has been applied to the measure of safety constructs for the purpose of selection with the Hazard Awareness Test (HAT) (Burt, 2017b). The HAT uses "spot the difference" puzzles to measure hazard awareness, which involves the presentation of a set of two images that appear very similar, but have minor differences between them. Specifically, the HAT has 10 sets of images that have 5 safety related differences, and 5 neutral images. An example of a safety related difference includes a parson wearing a hard hat compared to a person wearing a sun hat, while an example of a neutral difference includes a person wearing a red shirt compared to a person wearing a blue shirt. When tasked with identifying a specific number of differences between the images, those people that spot more safety related differences are said to have greater hazard awareness than those people that spot more neutral differences. In an investigation of the validity of the HAT, Shaw (2013) found the results of the puzzles to have significant relationships with measures of employee safety knowledge and motivation, as well as co-worker caring.

While hazard awareness is an important aspect of safety outcomes, it is not the only variable at play. As shown in Figure 1, hazard awareness is the first step of a larger process, where individual and organisational factors also have an influence on safety outcomes. In the event that a hazard has been identified, the course of action that a person takes in response to that hazard can determine whether or not an accident occurs, and this action can be influenced by both individual factors and organisational factors. The individual factors influencing the action are likely to include one's own safety behaviour, while organisational factors may include policies around health and safety. As discussed in earlier sections, this sentiment is supported by Ramsey's (1989) Accident Sequence Model.

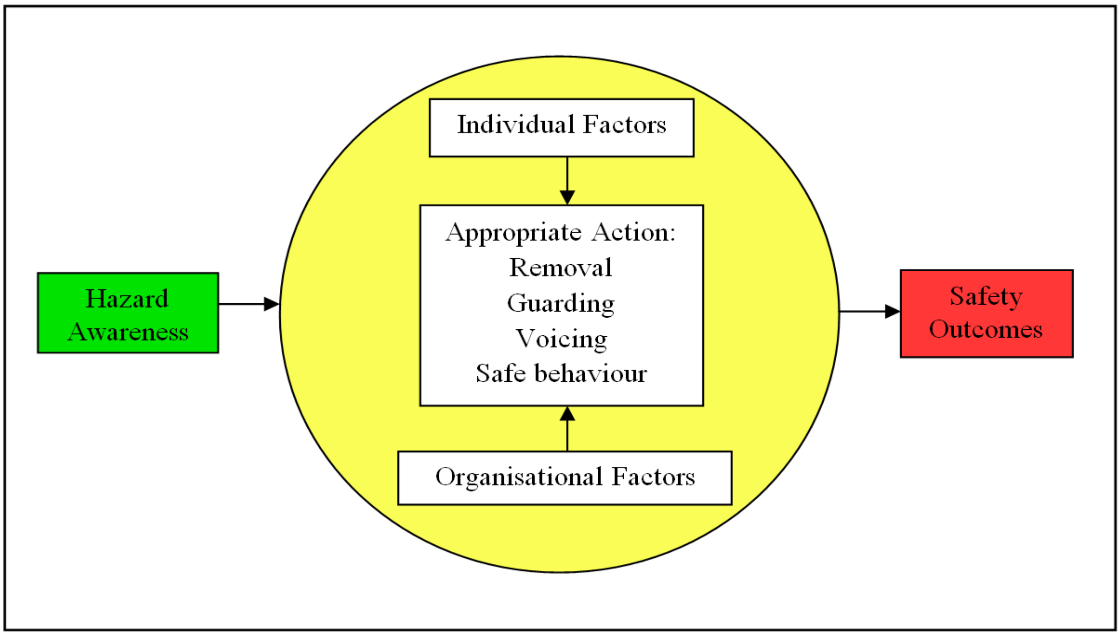


Figure 1: Illustration of how hazard awareness, individual factors, and organisational factors impact safety outcomes, from Burt (2015b).

While the HAT has been shown to measure hazard awareness, it does not measure the likelihood of a person acting appropriately in response to hazards. To capture the second aspect of the sequence shown in Figure 1, the Safety Behaviour Test (SBT) was developed. The SBT is a fully animated computer game of the click and point genre, meaning that the participant can point the cursor and click on an area in the game environment to interact with it. In the SBT, participants are given instructions to retrieve several different items from a warehouse with a forklift, and then load those items into a container. There are a number of different game design elements in the SBT, including a click counter, a timer, and feedback in the form of red crosses for inaccurate decisions. The game has 35 decision points that require action from the user in order to proceed. A subset of these decision points assesses the safety behaviour of the participant. A more detailed description of the SBT is provided in the method section.

Applying gamification to the measure of safety behaviour in this way has a number of advantages. Firstly, while the applicants may be aware that their safety behaviour is being tested, they will not know exactly what aspects of their game play are being measured. Therefore, the SBT will be much less susceptible to both the social desirability bias and impression management. Additionally, testing safety behaviour by having an applicant interact with a game means that actual behaviour can be tested, as opposed to asking an applicant how they have behaved in the past or how they may behave in the future. Finally, as gamification is associated with increased levels of engagement and motivation, those being tested with the SBT may be have more enthusiasm than those using self report, thereby performing to the best of their ability. As part of this study, participants were asked questions relating to the usability of the SBT. While these advantages are promising in regard to the use of the SBT in selection procedures, it is vital to investigate if the test is associated with any adverse impact, hence the aim of the current investigation.

1.6 Validation and Adverse Impact

A selection procedure that is valid is one that accurately and reliably measures the essential competencies required to do a given job (Biddle, 2005a). More specifically, a selection procedure that has criterion related validity is one that is effective in hiring people who can perform the job to a certain standard. There are a number of benefits to using a validated selection procedure for an organisation. Firstly, a selection procedure that does what it is designed to do will hire good workers into the organisation, which will mean increased productivity and revenue. Secondly, having a selection procedure that is invalid can be a huge waste of money in terms of turnover and production, therefore using a validated selection procedure can be cost saving. Finally, it is also important to ensure that a test has no adverse impact on any group of people. This aspect of the SBT is the primary focus of the current investigation.

An adverse impact is defined as “a substantially different rate of selection in hiring, promotion, or other employment decision which works to the disadvantage of members of race, sex, or ethnic group” (Biddle, 2005b) or in fact any other sub group. For example, written tests have historically had an adverse impact on particular ethnic groups, such as African Americans, that did not have access to the same level of education as other groups (Sackett, Schmitt, Ellington, & Kabin, 2001; Neisser et al, 1996). Additionally, physical ability tests have had an adverse effect on women, as men typically have greater body strength (Kuh, Bassey, Butterworth, Hardy, & Wadsworth, 2005). Adverse impacts in selection procedures have had a long history of legal battles, with arguably the most famous being that of Griggs vs. Duke Power Company in 1971 (Lerner, 1979). In this case, Duke Power Company was accused of adversely impacting African American people in their selection procedure by requiring a high school diploma. As this qualification was not found to be essential to performing the job under investigation, the court ruled the requirement to be a violation of civil rights (Huff, 1974).

In order to avoid having an adverse impact, many tests today have norms for different groups that are applied to test results. For example, the hand-tool dexterity test published by The Psychological Corporation reveals vastly different scores between males and females, and therefore has appropriate gender based norm group information that can be applied to individual scores. Additionally Raven’s Progressive Matrices, the non-verbal test of abstract reasoning, has different norms for different age groups for which to apply to the interpretation of results (Raven, Court, & Raven, 1985). Determining whether different individual characteristics influence or bias SBT scores is essential for using the SBT as a selection tool.

In addition to typical characteristics that may adversely impact performance on a test, such as gender and age, there are a number of additional characteristics that would possibly impact performance on the SBT. Firstly, familiarity with the simulation mode may provide users an advantage in using the SBT. As the SBT uses a forklift scenario to test people on safety behaviour, it is possible that people who have experience using forklifts would score higher on the test than people who do not have experience using forklifts. Additionally, as the SBT uses a computer game format, those people with computer game experience may have an advantage over people without computer game experience. Work experience may also potentially have an impact of SBT performance, given that this experience could be used to inform behaviour.

1.7 Current Investigation

The current the investigation assessed whether or not a person's age, work experience, gender, computer game experience, and forklift use experience have an impact on SBT performance. No specific hypotheses were formed for the investigation as, while it is not expected that any individual characteristics would impact SBT performance, it cannot be ruled out.

Method

2.0 Design

The current investigation used a concurrent validation design, with the exception that sampling was not conducted within a single organisation. In order to gather an appropriate sample size, participants were recruited from a variety of employee groups. Both the current investigation and the associated work by Crowe (2018) used data gathered by the SBT, however the two studies predominantly used two different questionnaires for respective investigations. Participants were tested on the SBT, and then completed the *individual* *characteristics questionnaire* (see Appendix A). Information gathered from the *individual characteristics questionnaire* was used to address the research question of the current investigation, of whether a person's individual characteristics have an identifiable impact on SBT use and performance. Additionally participants were to have one of their acquaintances, who were in a position to rate the participant's safety behaviour, complete the *acquaintance questionnaire* about the participant's safety behaviour (see Appendix B). Information gathered from the acquaintance questionnaire was used to address the research question of Crowe (2018) of whether the SBT has criterion related validity. Note: in the documents shown in the appendices, the SBT is referred to as the CPT (the Compliance and Participation Test) as the name of the test was changed during the completion of the current investigation. The current investigation was reviewed and approved by the University of Canterbury Human Ethics Committee, reference number HEC 2017/26.

3.1 Participants

3.1.1 Recruitment and Sampling

A haphazard sampling method was used, meaning that "the most available people" were sampled (Weisberg & Bowen, 1977, p. 19). While there is no guarantee that haphazard sampling will gather a sample that is representative of the larger population of interest, it is likely to do so if there is no source of bias. Specifically, participants in the current investigation were recruited using two different means. Firstly, organisations were contacted through email (see Appendix C) and telephone, and invited to take part in the study. Secondly, advertisements were displayed around the University of Canterbury in order to recruit students (see Appendix D). A total of 9% of the study sample were recruited via the later approach, thus the vast majority of participants were from organisations. Participants were required to be in either full time or part time work at the time of their participation in the investigation (a response to a relative question in the *individual characteristics questionnaire* indicated this requirement was met in all cases). All participants were given a $10 MTA petrol voucher after participating as a reward for taking part in the investigation.

3.1.2 Demographic Information

There were a total of 100 participants and 100 acquaintance participants in the current investigation and the associated work by Crowe (2018). Given this dissertation only focuses on the SBT participant – only their demographic information is provided here. There were 62 male participants (62%) and 38 female participants (38%). The youngest participant was 18 years old, while the oldest participant was 66 years old. The mean age of the participants was 41.65 years of age, with a standard deviation of 14.19. Participants reported an average total work tenure of 286.8 months, with a standard deviation of 158.

3.2 Materials

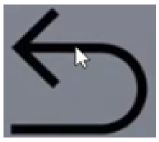
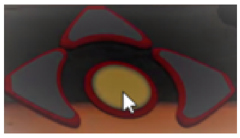
3.2.1 The SBT

The SBT utilises gamification to measure safety behaviour. The test is a fully animated computer game of the point and click genre, meaning that players must point the cursor at areas on the screen and click in order to interact with the game environment. First person views are used in the test, meaning that the player experiences the game through the eyes of the character in the game. A number of game design elements are included in the SBT, including a timer, a click counter, and feedback on decisions such as a red cross appearing after incorrect choices. In the SBT, players are given instructions to retrieve several different items from a warehouse with a forklift, and then load those items into a container. While a number of different task simulations would have provided a medium in which to measure safety behaviour, the warehouse loading scenario was chosen as it is an activity that any person can understand in a gamified setting. This means use of the SBT is not restricted to any particular employee group or job description.

The SBT is a standalone program that is hosted on the cloud and uploaded through the chrome web browser. A Lenovo ideapad 510-15ikb laptop was used to run the SBT for the duration of the study, which has a 15.6 inch screen. The test begins with the instruction page (see Figure 2) to explain to participants how to interact with the game environment. The instruction page shows images from the test, which are accompanied by explanations of how to navigate using various controls. For example, a door handle is shown with a mouse cursor on top of it, with a description that explains that the participant needs to point and click at the door handle to make the door open in the test. At the bottom of the instruction page is a button that reads "START". The instructions explain that once the participants have finished reading the instructions, they need to click this button to begin the test.

Test Instructions

Before you begin the test it is important that you understand how it works. Please carefully read the following points.

• This test is a work simulation in the format of a point and click video game. In the game you play the role of forklift driver number 1. You will enter a building which contains items you may interact with by clicking on them with the mouse pointer. For example to open a door, click on the door handle.	
• It is important to note that it may not be possible to go back in the game after clicking certain things such as a door handle, as this action will move you to the next area within the game. However, in some sections of the game a back arrow will appear in the bottom left corner of the screen. Clicking this will move you back in the game.	
• For a large part of the game you will be in a forklift. When you are in the forklift you can only control the game by clicking areas on the forklift control panel. **For example to select an item location, click on the level location on the control panel.** Controls that you can use within the forklift will change at various parts of the game.	
• The forklift directional control arrows will always be present. Click these in the middle of the arrow to control directional movements. You can only control directional movements when the forklift is stopped.	
• At one point in the game a yellow stop button will appear on the control panel. This button allows you to stop the forklift.	
• You can only control the test (e.g., select directional movements of the forklift) when the test is in **manual** mode. Clicking anything when the test is in **auto** mode will have no effect, and only waste clicks. Test mode is shown in the bottom middle of the screen.	**AUTO** **MANUAL**
• A mouse click counter is shown in the top left corner of the screen. **The test can be completed <u>perfectly</u> in 50 mouse clicks.**	Clicks Made 17/50

- Further instructions on what you need to do will be given when the game begins.
- Please close other tabs and don't have applications running in the background.
- When you click start the test will take several minutes to load. After which it will automatically start.

START

Figure 2: Instruction page for the SBT.

After clicking the "START" button on the bottom of the instruction page, the participants are presented with an office scene (see Figure 3). A sign on the desk in the scene reads "Press red button if unattended", which indicates that the participants needs to press the red button on the phone (which is the first decision point in the SBT). After pressing the red button on the phone, the participant hears the following audio: "*Hello forklift driver number 1. Sorry, I am up on level 6. It's good that you are here on time, there is only one job for you today. You have a shipment for disposal at the incinerator. The empty shipping container for the shipment is in loading dock C. A truck will take the loaded container to the incinerator as soon as you have finished loading it. I have already put the shipment items into the system, so when you get in a forklift the item list will be on the display screen. The new semi-automatic forklifts are working great, just click an item on the list and off you go to the relevant floor. Remember that control buttons appear when you need them. We have fixed the problem with the red right and left directional control arrows, and the central yellow stop button is working fine on all forklifts. Remember to load the items in the order shown on the list. The cloak room is nice and tidy this week, so let's keep it that way. Don't muck around as the transportation firm will charge us if they have to wait, but be careful. When you have got the order loaded come back here and let me know. If you would like me to repeat the instructions, just click the red button again*". After hearing the audio for the first time, participants are given the option to hear it again by pressing the red button for a second time. The audio is only able to be heard twice in total.

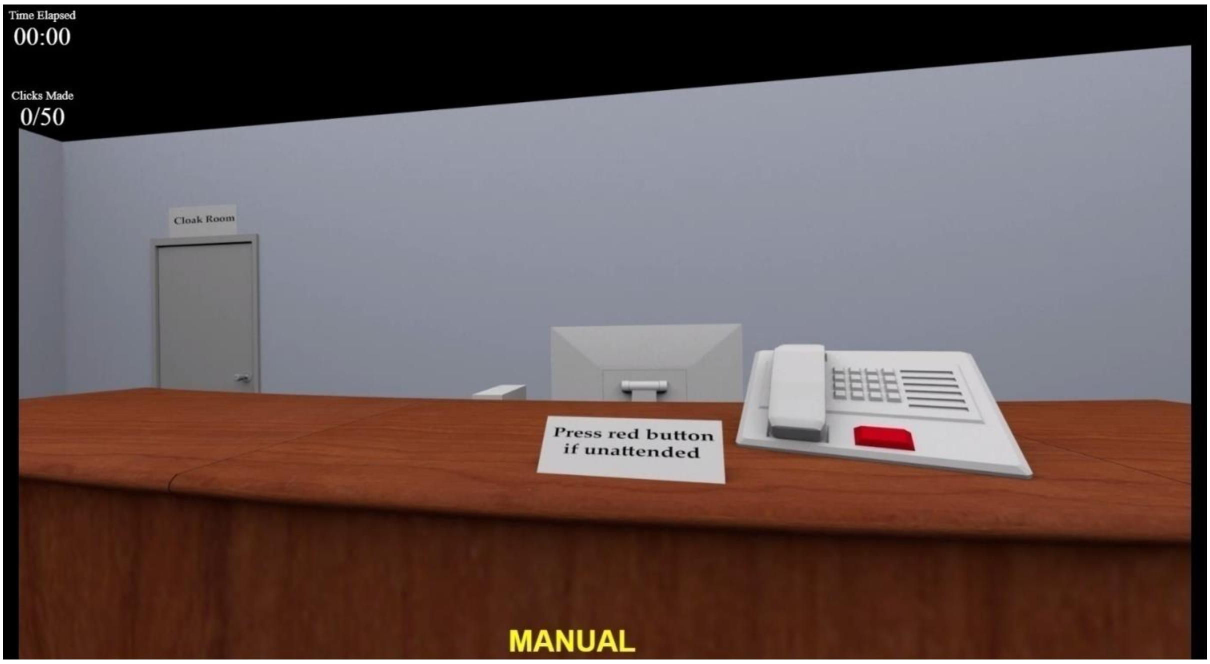


Figure 3: An image from the SBT, showing the front desk at the entry of the organisation in the test.

On the top left hand corner of the screen is the timer, which measures the time taken to complete the test. The timer begins when the participant clicks the red button on the phone for the first time. Below the timer is the click counter, which measures the number of clicks used during the test. As with the timer, the click counter begins recording when the participant first clicks the red button on the phone. The word “MANUAL” is shown on the bottom of Figure 3, indicating that the user has the ability at this point to take action. In this case, the user is able to press the red button on the phone. The timer, the click counter, and the auto/manual function remain in the same place on the screen for the duration of the test. After this point in the test, the participant is to complete the task of loading the items from the warehouse into the container, as outlined in the narrative instructions. Throughout the test, 35 decision points were captured under behavioural and response categories, where some decision points simply allowed progression through the test, while other decision points meant choosing to behave either safety or unsafely in the test environment. All measurement points were recorded and saved in a data file during test completion. Decision points related to safety choices were combined to create the SBT score. The SBT score can range from 0 to 13.

A full description of the test and the specific measurement points are not given past this point, as the confidentiality and security of the test needs to be maintained. The depositing of this dissertation in electronic form in the University of Canterbury library would compromise SBT security if a detailed description was provided here. Should a description of the test become publicly available, the usefulness of the test becomes significantly reduced (Burke, 2009).

3.2.1.1 SBT Development and Piloting

Over a three week period, the SBT was piloted with a range of different people in order to assess the usability of the test. A haphazard sampling method was used to obtain 10 participants for the pilot study (Weisberg & Bowen, 1977). In order to measure usability of the test, participants completed the test in view of the researchers, and were asked to discuss how usable they felt the test was once they had finished. The 10 participants that took part in the pilot study were each given a Warehouse voucher to the value of $10 for their time. As a result of the pilot study, the written instruction page shown in Figure 2 was created to increase clarity. Furthermore, slight alterations were made to the test itself, such as allowing the verbal instructions played after clicking the red button on the phone to be heard for a second time.

In order to determine if the decision points in test were being accurately recorded and saved on the data file, the researchers of the study completed the test using a range of different decisions, and manually recorded which specific decisions were being made correctly. The manual scoring sheet was compared to the data file produced by the SBT, and changes were made to the scoring system in the test based on any discrepancies found. This process was continued until the SBT was deemed to be correctly recording decision points.

3.2.2 Individual Characteristics Questionnaire

The *individual characteristics questionnaire* contained two sections. In the first section, demographic information was assessed. Specifically, the participant's gender, age, computer game experience, work experience, forklift use experience, accident history, job risk, health and safety training experience, and SBT usability was assessed.

Computer game experience was assessed using four questions. Participants were first asked if they have played a computer game before using the SBT. If participants indicated they had not used computer games, they were instructed to ignore the three remaining questions regarding computer game experience, and move to the next section of the questionnaire. If participants indicated they had used computer games before, they were to answer the three remaining questions regarding computer game experience, including how many years and months they had been playing computer games for, if they had ever played a point and click game, and how often they play computer games.

Forklift use experience was assessed using six questions. Participants were first asked if they had ever driven a forklift. If participants indicated they had not driven a forklift, they were instructed to ignore the remaining five questions regarding forklift use experience, and move on to the next section of the questionnaire. If participants indicated they had driven a forklift before, they were to answer the remaining five questions regarding forklift use experience, including if they had a forklift licence and how long they had had a forklift licence for, how many jobs they had worked in that required them to use a forklift, how many years and months they had worked in jobs that required them to use a forklift for, and how many forklift training programmes they had experienced.

Work experience was assessed using six questions. These questions included whether the participants worked full time or part time, how many years and months they had worked in their current job for, how many co-workers they had, how many different jobs they had worked in total, how many years and months they had worked for in total, and how many different organisations they had worked for. Participants were asked to complete all questions assessing work experience.

In order to assess accident history, participants were asked how many near misses (which could have resulted in injury or damage), minor injuries (which required medical attention such as first aid treatment or a visit to a doctor), and lost time injuries (that required time off work) they had experienced. For each of these types of accidents, participants were asked to indicate how many occurred at work, at home, or in another location such as while on holiday or during recreation.

Job risk was assessed by asking participants to indicate the safety risk associated with their current job by placing a mark on a 100 point scale. On the scale, a score of 0 indicated that the participant perceived their job to be not risky at all, while a score of 100 indicated that the participant perceived their job to be extremely risky.

Health and safety training experience was assessed using three questions. Participants were first asked if they had completed any health and safety training. If participants indicated they had not completed any health and safety training, they were instructed to ignore the two remaining questions regarding health and safety training, and move on to the next section in the questionnaire. If participants had completed health and safety training before, they were to answer the two remaining questions regarding health and safety training, including how many different training programmes related to health and safety training they had completed, and how many hours of health and safety training they had completed.

SBT usability was assessed using five seven-point rating scales. Participants were to circle the number on the scale to indicate their response to the questions asked regarding the SBT. The first question was “how understandable were the instructions given to you to use the SBT”, for which 1= not at all, and 7= completely. The second question was “how easy was it to control the forklift in the SBT”, for which 1= very hard, and 7= very easy. The second question was “how appropriate was the speed that the forklift moved in the SBT”, where 1= very inappropriate, and 7= very appropriate. The fourth question was “overall, how easy was it to complete the SBT”, for which 1= very hard, and 7= very easy. The fifth question was “how much did you enjoy completing the SBT”, for which 1= not at all, and 7= completely. For each question, a higher number indicated greater SBT usability. Finally, participants were asked if they had any other comments in regard to using the SBT, for which they had space to provide feedback on using the SBT.

The second section of the individual characteristics questionnaire contained four established safety scales, with a total of 27 items between them. These scales were used predominately in the work of Crowe (2018). The four scales measured safety compliance and participation, safety voicing, safety consciousness and risk taking, and rule bending respectively, as described below. While the scales were not labelled in the *individual characteristics questionnaire* during the investigation, they are labelled in the appendix for clarity of the reader. Responses on all scales were obtained using a five-point likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree/disagree, 4 = agree, 5 = strongly agree). Scale scores were formed by summing the items ratings and dividing the sum by the number of scale items. As scale scores increase, they indicate more of the construct measured.

Safety compliance and participation was measured using two sections of Neal and Griffin’s (2006) validated scale of safety climate, motivation, and behaviour, where safety behaviour was made up of safety compliance and participation. Three items in the scale measure safety compliance, while three items measure safety participation. Examples of items include “*I use all the necessary safety equipment to do my job*”, and “*I promote the safety program within the organisation*” for safety compliance and participation respectively. A coefficient alpha of .93 and .86 respectively for safety compliance and safety participation was reported by Burt, Banks, and Williams (2014). The current investigation found an alpha of .86 and .87 for safety compliance and safety participation, respectively.

Safety voicing was measured using a section of Tucker, Chmiel, Turner, Hershcouis and Stride’s (2008) validated scale of employee safety voicing, perceived organisational support for safety, and perceived co-worker safety support. Five items make up the safety voicing scale in total. Examples of items in the scale include “*I make suggestions about how safety can be improved*”, and “*I tell my colleague who is doing something unsafe to stop*”. The original scale by Tucker et al. (2008) reported a coefficient alpha of .78. The current investigation found an alpha of .83.

Safety consciousness and risk taking was measured using Westaby and Lee’s (2003) validated scale of safety consciousness and risk taking. Seven items in the scale measure safety consciousness, while five items measure risk taking. Examples of items include “*I always take extra time to do things safely*”, and “*I would rather take risks than be overly cautious*” for safety consciousness and risk taking respectively. The original scale by Westaby and Lee (2003) reported a coefficient alpha of .77 and .85 for safety consciousness and risk taking respectively. The current investigation found an alpha of .84 and .82 for safety consciousness and risk taking, respectively, however a better alpha of .87 was found for risk taking after item four was removed.

Rule bending was measured using Chmeil’s (2005) validated scale of bending the rules. Four items make up the rule bending scale in total. Examples of items in the scale include “*I cut corners if it makes the task easier*”, and “*work pressures mean that I bend safety rules”*. The original scale by Chmeil (2005) reported a coefficient alpha of α=.82. The current investigation found an alpha of α=.83.

3.3 Procedure

The testing took place in a quiet room so as to minimise distractions to the participants. In the case of sampling students, participants were tested in room 607b in the Psychology Department at the University of Canterbury. In the case of sampling employees that were contacted through their organisation, participants were tested at their work place in a room provided. Participants were first given the *participant information sheet* that explained the purpose of the investigation (see Appendix E), and then the *participant consent form* (see Appendix F). After consenting, participants were taken to the laptop and told “*This is the instruction page of the test. Please read the instructions carefully, as you will only be able to see them once. Press the start button when you are ready to take the test. I will leave you to take the test privately, and will be waiting outside of the room for when you have finished. Please imagine that you have applied for a job. The test you are about to complete is being used to determine your suitability for the job. As a job applicant, try to do your best on the test*”. The researcher then left the room, allowing the participant privacy to complete the test in their own time.

Once the participant had completed the SBT, they were given the *individual characteristics questionnaire* to complete. A numerical code was written on the top of the questionnaire by the researcher that matched a code entered into the SBT before the participant had taken the test. These codes were used in order to match the participants test results to their questionnaire results during data analysis while maintaining participant confidentiality. Again, the researcher left the room, allowing the participant to complete the questionnaire in private and in their own time. Next, in the case of sampling students, participants were given an unsealed envelope containing an *acquaintance information sheet* (see Appendix G), and *acquaintance consent form* (see Appendix H), and an *acquaintance questionnaire*. The same numerical code that had been written on the participant's individual characteristics questionnaire was written on the top of the corresponding acquaintance questionnaire by the researcher, again to be able to match data in Crowe's (2018) investigation while maintaining participant confidentiality.

The participants then had a number of things explained to them by the researcher. Firstly, they were shown the contents of the envelope, and told that the acquaintance that they chose to give the envelope to needed to first read the information sheet, sign the consent form if they give their consent to take part in the study, and finally complete the questionnaire. Secondly, they were told to explain to their acquaintance that they needed to put the signed consent form and completed questionnaire back in the envelope, seal the envelope, and give it back to the participant. Thirdly, participants were told that the acquaintance they chose to give the envelope to had to be in a position to rate the participant's safety behaviour. Finally, participants were told to return the sealed envelope to room 607b at the University of Canterbury, at which point they would receive a $10 MTA petrol voucher for themselves, and a $10 MTA petrol voucher to give to their acquaintance.

In the case of sampling employees at their work place, a supervisor or manager of the employees was used as the acquaintance. The acquaintance was first given the *acquaintance information sheet*, and then the *acquaintance consent form*. After consenting, the acquaintance was given the *acquaintance questionnaire* to complete. Both the participants and the acquaintances were given a $10 MTA petrol voucher upon completion of their respective questionnaires.

Results

3.0 Data Preparation

Missing data from the scale rating responses were replaced with the mean for that item. Table 2 shows the scale items that had missing data, the number and percentage of missing data from each scale item, and the mean that the missing data was replaced with. Any missing data from biographical questions was not replaced, resulting in a smaller number of cases for some variables.

Table 2.

The number and percentage of responses that were missing from items in self report scales, and the mean response for that item that was used to replace missing responses.

Scale with missing responses	Item with missing responses	Number and percentage of missing responses	Mean value used to replace missing responses
Safety compliance scale	Item 3	1	4.25
Safety participation scale	Item 2	2	3.85
Rule bending scale	Item 1	3	2.55
	Item 4	2	2.29
Safety voicing scale	Item 1	6	3.75
	Item 2	1	4.10
Safety consciousness scale	Item 1	1	3.83
	Item 3	2	3.83
	Item 5	1	3.66
SBT usability	Understand instructions	3	5.06
	Ease to control forklift	2	5.39
	Appropriate game speed	2	5.25
	Ease to complete	2	5.11
	Enjoy completing	2	5.06

Given that extreme responses can distort results (Field, 2009), the data was examined for outliers An outlier rule of plus or minus three standard deviations from the mean was applied. Several responses which met the classification of an outlier were identified. Any responses that were more or less than three standard deviations away from the variable mean were removed. A total of five responses were removed from five different variables in the *individual characteristics questionnaire*, as shown in Table 3.

3.1 Individual Characteristics Questionnaire Descriptive Statistics

Table 3 presents descriptive statistics (after outlier removal) for the variables measured in the *individual characteristics questionnaire* to assess for adverse impact on SBT performance. The number of cases, means, standard deviations, range scores, the number of outliers removed, skewness, and kurtosis are shown for each variable. In addition to having missing data in the biographical measures that were not replaced, the number of cases for each variable are different, as responding "no" to some questions in the *individual characteristics questionnaire* meant that participants did not have to answer subsequent questions. For example, if participants indicated that they had never played a computer game, they did not have to answer the remaining questions regarding computer game experience.

Initially it was planned to examine if experience with point and click computer games impacted SBT performance, but with only 10 participants indicating that they had played a point and click computer game, this analysis was not undertaken. Similarly, it was planned to examine if holding a forklift licence impacted SBT performance, but with only 19 participants of those that had ever driven a forklift indicating that they did not hold a forklift licence, the analysis was not undertaken.

Table 3.

The number of cases, mean, standard deviation, range, number of outliers removed, skewness, and kurtosis for the individual characteristics of the participants.

Individual characteristics	N=	Mean (SD)	Range	Number of outliers removed	Skewness (SE)	Kurtosis (SE)
Months spent in current job	97	82.67 (87.26)	0-360	1	1.31 (.24)	1.14 (.48)
Number of different jobs worked	95	5.91 (3.32)	0-15	1	1.14 (.24)	1.17 (.49)
Months spent working in total	96	286.86 (158.87)	11-600	0	-.05 (.24)	-1.09 (.48)
Number of different organisations worked in	90	5.58 (2.92)	1-15	1	1.11 (.25)	1.40 (.50)
Months playing computer games	33	177.96 (130.3)	19-480	0	.61 (.40)	-.51 (.79)
Months with forklift licence	48	101.10 (106.51)	0-456	1	1.74 (.34)	3.10 (.67)
Number of jobs worked requiring forklift use	58	2.34 (2.03)	0-10	0	2.10 (.31)	5.69 (.61)
Months worked in jobs requiring forklift use	44	119.49 (117.96)	0-494	0	1.24 (.32)	1.03 (.63)
Hours of forklift training	49	18.83 (38.46)	0-200	1	3.22 (.34)	11.42 (.66)
Perceived job risk	98	42.46 (28.33)	0-100	0	.232 (.24)	-1.12 (.48)

Table 4 presents the frequency of responses to the question regarding how often participants play computer games, of the participants that indicated they had played computer games before. In addition to the descriptive statistics shown in the current section, descriptive statistics regarding the age and gender of the participants are discussed in section 2.1 of the method, and descriptive statistics regarding whether participants had played computer games before or not, and had driven a forklift before or not, are shown in sections 3.3.3 and 3.3.4 respectively.

Table 4.

Frequency table of how often participants play computer games, of the participants that indicated they had played computer games before.

How often participants play computer games	Frequency (N=39)
Daily	11
Weekly	1
Monthly	6
Once every six months	8
Once a year	13
Less than once a year	0

3.2 SBT Measure Descriptive Statistics

As discussed in section 3.2.1 of the method section, decision points in the SBT were combined to create the measure of *SBT score*. A larger *SBT score* indicates more safety behaviour was demonstrated within the play sequence. The *SBT score* had a possible score range of 0 to 13. Descriptive statistics for the *SBT score* are shown in Table 5. Inspection of these statistics indicates a good range, with no major issues of skew.

The analysis also examined the time taken to complete the SBT. Time taken to complete the SBT is not considered to be a measure of safety behaviour, as evidenced by a non-significant correlation with *SBT score* (r=-.03). Despite this finding, time taken to complete the SBT in seconds is included in the analysis as test time is a variable of practical significance in relation to future SBT use. The measure of time taken to complete the SBT in seconds is referred to as *SBT test time*. Two cases from *SBT test time* were removed for meeting the classification of an outlier, as indicated in Table 5.

Table 5.

The number of cases, mean, standard deviation, range, skewness, and kurtosis for the SBT measures.

SBT measures	N=	Mean (SD)	Range	Skewness (SE)	Kurtosis (SE)
SBT score	100	8.0 (2.72)	0-13	-.45 (.24)	-.06 (.47)
SBT test time (seconds)	98	1079.14 (170.72)	787-1569	.82 (.24)	.13 (.48)

3.3 Distortion in Self Report Data

Before investigating potential adverse impact, a key assumption behind the development of the SBT was examined. The assumption which prompted the development of the SBT is that individuals will distort their self report of safety behaviour based on social desirability and impression management processes (Krumpal, 2013). This distortion is predicted to result in an inflation of positive safety behaviour reporting and a reduction of negative safety behaviour reporting. The data collected allowed for these predictions to be examined. Comparison of the self ratings on the safety scales in the *individual characteristics questionnaire* and the acquaintance ratings on the same safety scales in the *acquaintance questionnaire* generally supported the predictions. Table 6 presents the independent samples *t*-test results comparing means ratings on the safety scales. The means and the *t*-test results indicate that there are significant differences between the self ratings and the acquaintance ratings for the scales of *safety voicing*, *safety compliance*, and *safety participation*. Specifically, as indicated by the means, the average self ratings were higher than the average acquaintance ratings for the safety scales for which there were significant between group differences. These results indicate that the participants were reporting themselves to be safer than their acquaintance reported them to be, thereby supporting the self reporting bias.

Table 6.

Independent sample t-test results for the self ratings and acquaintance ratings on the safety scales.

Safety scales	Self rating (N=100)	Acquaintance rating (N=100)	*t*-test result (df=99)
Safety voicing	3.90 (.64)	3.67 (1.12)	-2.10*
Safety compliance	4.25 (.67)	4.03 (.95)	-2.11*
Safety participation	3.87 (.81)	3.52 (1.20)	-2.84**
Safety consciousness	3.79 (.60)	3.63 (.78)	-1.76
Rule bending	2.52 (.91)	2.35 (1.00)	-1.29
Risk taking	2.24 (.95)	2.06 (.09)	-1.78

*p<0.05, **p<0.01

3.4 Adverse Impact

Sections 3.4.1 to 3.4.6 test for relationships between age, work experience, gender, computer game experience, forklift use experience, and perceived job risk, and the SBT measures in order to identify any variables associated with SBT performance. The objective is to ensure that individuals administered the SBT are neither advantaged nor disadvantaged by a variable that is not reflective of their safety behaviour. In this regard, it would be expected that safety behaviour and the processes which develop safety behaviour will co-vary with some of these variables. This was examined by correlating age and work experience with the individuals reported health and safety training experience.

Two questions in the *individual characteristics questionnaire* addressed health and safety training experience. Firstly, participants were asked how many different health and safety training programmes they had completed, and secondly, they were asked how many hours of training related to health and safety they had completed. Table 7 shows the descriptive statistics for the health and safety training experience questions.

Table 7.

The number of cases, mean, standard deviation, range, skewness, and kurtosis for the health and safety training experience variables.

Health and safety training experience variables	N=	Mean (SD)	Range	Skewness (SE)	Kurtosis (SE)
Number of different training programmes	70	3.41 (2.26)	1-10	1.22 (.28)	1.34 (.56)
Number of hours spent training	69	16.91 (22.04)	1-100	2.55 (.28)	7.06 (.57)

Table 8 shows the correlations between age and work experience, and the two health and safety training related questions. Inspection of Table 8 supports the above assumptions, as both *age* and *months spent working in total* are positively correlated with *number of different training programmes*, and *number of hours spent training*. Thus, when examining the impact of age and work experience on the SBT measures, health and safety training experience was controlled for. In order to control for health and safety training experience, a composite measure was created by summing the measures of the number of different training programmes and the number of hours of training. This composite measure is referred to as *health and safety training experience composite*. As only 79 participants indicated that they had experienced health and safety training, the number of cases in the analyses in which health and safety training experience is controlled for is smaller than the total sample size.

Table 8.

Pearson correlations between the health and safety training experience measures, and the individual characteristics of age and months spent working in total.

Health and safety training experience variables	Age (N=70)	Months spent working in total (N=68)
Number of different training programmes	.21	.22
Number of hours spent training†	.23*	.16

*p<0.05

†After removing outliers from *number of hours spend training*, N=69 and N=67 for *age* and *total job tenure* respectively.

3.4.1 Age

Table 9 presents the partial correlations between the age of the participant and the SBT measures, controlling for *health and safety training experience composite*. Inspection of Table 9 reveals that there is no significant correlation between the age of the participant and *SBT score*. Even in the absence of controlling for health and safety training experience, the relationship between age and SBT score is not significant (r=-.02). Table 9 did reveal a significant correlation between the age of the participants and *SBT test time*. The positive correlation indicates that the older the participant was, the more time they took to complete the SBT. However, given that *SBT score* and *SBT test time* are not significantly correlated, these findings indicate that the age of the participant is not associated with a significant difference in performance, suggesting there is no adverse impact of age on SBT performance.

Table 9.

Partial correlations between mean scores on the SBT measures and the age of the participants, controlling for health and safety training experience composite.

SBT measures	Age (N=63)
SBT score	.00
SBT test time (seconds)	.41**

**p<0.01

3.4.2 Work experience

A number of variables measuring work experience were collected. Table 10 presents the partial correlations between the SBT measures, and the work experience measures of *months spent in current job*, *number of different jobs worked*, *months spent working in total*, and *number of different organisations worked in*, controlling for *health and safety training experience composite*. Additionally, a composite measure of work experience was created by summing the measures of *months spent in current job*, *number of different jobs worked*, *months spent working in total*, and *number of different organisations worked in*. This composite is referred to as *work experience composite*, and is shown in Table 10.

As shown in Table 10, there were no significant correlations between any of the work experience measures and *SBT score*. Inspection of Table 10 did reveal significant correlations between *SBT test time* and the work experience measures of *months spent working in total* and *work experience composite*. The positive correlations in both of these instances indicate that the greater work experience that participants had, the more time they took to complete the SBT. However, given that *SBT score* and *SBT test time* is not significantly correlated, these findings indicate there is no adverse impact of work experience on SBT performance.

Table 10.

Partial correlations between mean scores on the SBT measures and the work experience measures, controlling for health and safety training experience composite.

SBT measures	Months spent in current job (N=57)	Number of different jobs worked (N=57)	Months spent working in total (N=57)	Number of different organisations worked in (N=57)	Work experience composite (N=57)
SBT score	-.05	-.02	.08	.03	.03
SBT test time (seconds)	.13	.07	.39**	.05	.34**

*p<0.05, **p<0.01

3.4.3 Gender

Table 11 shows the independent sample *t*-test results comparing means on the SBT measures between the male and female participants. Inspection of Table 11 indicates that there are no significant differences between male and female participants in regard to either *SBT score* or *SBT test time*, suggesting there is no adverse impact of gender on SBT performance.

Table 11.

Independent sample t-test comparing mean scores in the SBT measures between males and females.

SBT measures	Male Mean (SD) N=62	Female Mean (SD) N=38	*t*-test result (df=98)
SBT score	7.91 (2.92)	8.26 (2.39)	-.61
SBT test time (seconds) †	1083.58 (166.70)	1072.13 (178.94)	.24

†After removing outliers from *SBT test time*, N=60 and N= 68 for male and female participants respectively, and df=96 for the *t*-test.

3.4.4 Computer Game Experience

Table 12 presents the independent sample *t*-test results comparing mean scores for the SBT measures between participants that had never played computer games (N=62), and participants that had played computer games (N=36). Inspection of Table 12 reveals a significant difference in *SBT score* between those participants that had never played computer games and those participants that had played computer games. Inspection of means shows that those participants that had played computer games had a greater average SBT score compared to those participants that had never played computer games. Additionally, Table 12 reveals a significant difference in mean scores for *SBT test time* between those participants that had never played computer games and those participants that had played computer games. Inspection of the means indicates that those participants that had never played computer games took more time to complete the SBT than those participants that had played computer games.

Table 12.

Independent sample t-test comparing mean scores on the SBT measures between participants that had never played computer games and participants that had played computer games.

SBT measures	Had never played computer games Mean (SD) N=62	Had played computer games Mean (SD) N=36	*t*-test result (96)
SBT score	7.66 (2.66)	8.91 (2.61)	-2.26*
SBT test time (seconds) †	1114.85 (178.56)	1018.00 (144.72)	2.75**

*p<0.05, **p<0.01

†After removing outliers *SBT test time,* N=60 for participants that had never played computer games, and df=94 for the *t*-test.

Table 13 presents Pearson correlations between the SBT measures and *months playing computer games*. Additionally, a composite measure of computer games experience was created by summing the measures of *months playing computer games* and *how often participants play computer games*. This composite measure is referred to as *computer game experience composite*, and is shown in Table 13. As shown in Table 13 there are no significant correlations between the SBT measures and the measures of computer game experience. However, the results shown in Table 12 indicate that playing computer games may increase a person's SBT score, suggesting a potential adverse impact of computer game experience on SBT performance.

Table 13.

Pearson correlations between mean scores on the SBT measures and the computer game experience measures.

SBT measures	Months playing computer games N=33	Computer game experience composite N=32
SBT score	-.05	-.05
SBT test time (seconds) †	.19	.17

†After removing outliers *SBT test time*, N=32 for *months playing computer games*.

3.4.5 Forklift Use Experience

Most of the tasks in the SBT require the user to move goods within the test environment using a forklift. While the forklift is largely automatically controlled within the test, it was decided to test for any adverse impact of forklift use experience on SBT performance. Table 14 shows the independent sample *t*-test results comparing mean scores on the SBT measures between participants that had never driven a forklift (N=43) and participants that had driven a forklift (N=57). Inspection of Table 14 shows there are no significant differences on the SBT measures between those participants that had never driven a forklift and those participants that had driven a forklift.

Table 14.

Independent sample t-test comparing mean scores on the SBT measures between participants who have driven a forklift before and participants who have driven forklifts before.

SBT measures	Had never driven a forklift Mean (SD) N=43	Had driven a forklift Mean (SD) N=58	*t*-test result (df=98)
SBT score	8.16 (2.49)	7.96 (2.90)	.35
SBT test time (seconds) †	1044 (148.73)	1105.85 (183.02)	-1.77

†After removing outliers from *SBT test time*, N=55 for participants that had driven a forklift, and df=96 for the *t*-test.

Table 15 presents the Pearson correlations between the participant characteristics of *months with forklift licence*, *number of jobs worked requiring forklift use*, *months worked in jobs requiring forklift use*, and *hours of forklift training*, and the SBT measures. Additionally, a composite measure of forklift use experience was created by summing the measures of *months with forklift licence*, *number of jobs worked requiring forklift use*, *months worked in jobs requiring forklift use*, and *hours of forklift training.* This composite measure is referred to as *forklift use experience composite*, and is shown in Table 15.

Inspection of Table 15 reveals there were no significant correlations between any of the SBT measures and any of the forklift use experience variables. These results, combined with the results shown in Table 14, indicate that neither having forklift use experience nor having a particular degree of forklift use experience is associated with higher or lower SBT performance, suggesting forklift use experience does not adversely impact SBT performance.

Table 15.

Pearson correlations between mean scores on the SBT measures and the forklift use experience measures.

SBT measures	Months with forklift licence N= 48	Number of jobs worked requiring forklift use N= 58	Months worked in jobs requiring forklift use N=55	Hours of forklift training N= 49	Forklift use experience composite N=39
SBT score	-.04	-.06	-.17	.16	-.03
SBT test time (seconds) †	.19	-.16	.11	.25	.23

†After removing outliers from *SBT test time*, N=46, N=56, N=53, N=47, and N=37 for *months with forklift licence*, *number of jobs worked requiring forklift use*, *months worked in jobs requiring forklift use*, *hours of forklift training*, and *forklift use experience composite* respectively.

3.4.6 Perceived job risk

Table 16 presents the Pearson correlations between the SBT measures and the participant ratings of the safety risk of their current job, referred to as *perceived job risk*. Inspection of Table 16 indicates that there are no significant relationships between any of the SBT measures, and *perceived job risk*. These results indicate that there is no adverse impact of perceived job risk on SBT performance, meaning that people who work in a risky environment appear to have neither an advantage nor a disadvantage in using the SBT.

Table 16.

Pearson correlations between mean scores on the SBT measures and the perceived job risk of participants.

SBT measures	Perceived job risk N= 98
SBT score	.01
SBT test time (seconds) †	.00

†After removing outliers *SBT test time*, N=96 for *perceived job risk.*

3.5 SBT Usability

While not strictly a variable which related to the classic idea of adverse impact, usability can easily impact a person's performance on the SBT, and in turn bias their score. Furthermore, as the current investigation is the first undertaken on the SBT, improvements in usability can be made before further research is undertaken. For these reasons, several questions were included in the *individual characteristics questionnaire* to examine usability, including how well the participant understood the instructions, how easy they found controlling the forklift, how appropriate they found the speed of game play, how easy they felt it was to complete the SBT overall, and how much they enjoyed playing the game. Table 17 presents descriptive statistics for the SBT usability questions, including the number of cases, mean, median, standard deviation, minimum, maximum, skewness and kurtosis. As shown Table 17, the means and medians are relatively high, indicating that the participants on average rated the SBT as being useable.

Table 17.

Descriptive statistics for questions regarding SBT usability.

SBT usability questions	N=	Mean (SD)	Median	Range	Skewness (SE)	Kurtosis (SE)
Understand instructions	100	5.06 (1.33)	5	2-7	-.50 (.24)	-.29 (.47)
Ease to control forklift	100	5.39 (1.50)	6	1-7	-.78 (.24)	-.20 (.47)
Appropriate game speed	100	5.25 (1.44)	6	2-7	-.64 (.24)	-.49 (.47)
Ease to complete	100	5.11 (1.49)	5	1-7	-.67 (.24)	-.28 (.47)
Enjoy completing	100	5.06 (1.63)	5	1-7	-.85 (.24)	.17 (.47)

Table 18 presents the Pearson correlations between the SBT measures, and the participant usability ratings of the SBT, including *understand instructions*, *ease to control forklift*, *appropriate game speed*, *ease to complete*, and *enjoy completing*. Additionally, a composite measure of SBT usability was created by summing the usability measure of *understand instructions*, *ease to control forklift*, *appropriate game speed*, *ease to complete*, and *enjoy completing*. The composite measure is referred to as *SBT usability composite*, and is shown in Table 18.

Inspection of Table 18 revealed that none of the SBT usability measures are significantly correlated with *SBT score*. Inspection of Table 18 also revealed significant correlations with *SBT test time* and the SBT usability ratings of *understand instructions* and *ease to complete* respectively. The negative correlation between *understand instructions* and *SBT test time* indicates that the higher the participants rated the usability of the SBT in terms of having understandable instructions, the less time they took to complete the SBT. Similarly, the negative correlation between *ease to complete* and *SBT test time* indicates that the higher the participants rated the usability of the SBT in terms of being easy to complete, the less time they took to complete the SBT. However, given that *SBT score* and *SBT test time* are not significantly correlated, these findings indicate that the usability ratings of the SBT are not associated with significantly different SBT performance. While there is no indication that usability has an impact on SBT performance, the findings do indicate that some improvements on the SBT instructions could be made.

Table 18.

Pearson correlations between mean scores on the SBT measures and the SBT usability measures.

SBT measures	Understand instructions N= 100	Ease to control forklift N= 100	Appropriate game speed N=100	Ease to complete N= 100	Enjoy completing N=100	SBT usability composite N=100
SBT score	.10	.13	.15	.06	.02	.12
SBT test time (seconds) †	-.25*	-.04	-.05	-.28**	-.14	-.19

*p<0.05, **p<0.01

† After removing outliers from *SBT test time*, N=98 for all SBT usability measures.

Table 19 presents the Pearson correlations between *SBT usability composite*, and the individual characteristic variables of *age*, *computer game experience composite*, *forklift use experience composite,* and *work experience composite*. Inspection of Table 19 reveals no significant correlations between *SBT usability composite* and the individual characteristics, indicating that none of the individual characteristics are impacting SBT usability.

Table 19.

Pearson correlations between SBT usability composite and the individual characteristics.

Individual characteristics	SBT usability composite
Age	-.09 (N=99)
Computer game experience composite	.05 (N=32)
Forklift use experience composite	-.06 (N=39)
Work experience composite	.05 (N=85)

3.6 Adverse Impact and Validation of the SBT

After testing the relationships between age, work experience, gender, computer game experience, forklift use experience, and job risk, and the SBT measures, only computer game experience was identified as potentially adversely impacting SBT performance. To address this finding, computer game experience was controlled for in the validation work reported in Crowe's (2018) dissertation. The summary of results from Crowe (2018) shown in Appendix I presents the outcome of the validation of the SBT against the independent safety behaviour ratings, after controlling for computer game experience.

Discussion

4.0 Summary of General Findings

The aim of the current investigation was to determine whether a person's individual characteristics have an identifiable impact on SBT use and performance. In order to achieve this, a series of analyses looking at the relationship between individual characteristics and SBT score were conducted. Furthermore, SBT test time and SBT usability were examined, as these components are of practical significance to future SBT use. The investigation was conducted in order to address the demand for a new measure of safety behaviour that does not rely on self report or accident history analysis.

4.0.1 Self and Acquaintance Ratings

The development of the SBT was based on the assumption that self report measures are open to distortion and that, given the importance of safety in the work place, organisations are in dire need of a measure that can provide unbiased information upon which to predict future safety behaviour. The assumption that individuals will distort their self report of safety behaviour based on social desirability and impression management processes was supported by the findings of the investigation. Specifically, on all of the safety scales in which a higher score indicated greater safety behaviour of the individual, the average score for the self ratings were higher than the independent ratings by an acquaintance of the individual. However, the average scores for the self ratings were also higher than the average independent ratings on safety scales in which a higher score indicated poorer safety behaviour (specifically the rule bending and risk taking scales). These findings were unexpected, as participants were predicted to rate themselves more favourably than acquaintances rated them on all scales.

It is possible that these unexpected findings are the result of biased responding by the acquaintances of the individuals being rated. When using the safety behaviour scales where a higher score indicates a positive outcome, the acquaintances must consider and report on how much of a positive attribute the individual has. Conversely, when using the safety behaviour scales where a lower score indicates a negative outcome, the acquaintances must consider and report on how much of a negative attribute a person has. It may be the case that raters find it easier to rate people lower in a positive attribute than higher in a negative attribute. This may be particularly true in the current investigation as the acquaintance likely has a personal relationship with the person they are rating. This pattern of responding by the acquaintances would result in generally higher scores on the safety behaviour scales where a higher score indicates a positive outcome, and lower scores on the safety behaviour scales where a higher score indicates a negative outcome, which is the outcome observed in the findings of the current investigation.

Alternatively, common method variance may be responsible for the unexpected results. Common method variance refers to the phenomenon where a pattern of results observed is attributable to the method of measurement used, as opposed to reflecting the actual relationship between variables being measured (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In this instance, given there were a greater number of safety behaviour scales in which a high score indicated a positive behaviour than there were the reverse, it is possible that individuals rating themselves habituated to rating themselves higher on the scale, which then impacted their ratings on subsequent scales. As common method variance has been found to be prevalent in behavioural measurement (Crampton & Wagner, 1994), it is possible that it had an impact in the current investigation.

4.0.2 Adverse Impact

As revealed in the results, computer game experience appears to be the only individual characteristic measured in the current investigation that presents as potentially having an adverse impact on SBT performance. One theory as to why this is occurring is that computer game players may view the SBT as a game as opposed to a test, and will therefore use the SBT with different motives that non-computer game players. In a study by Frank (2012), it was revealed that in the case of games used for training and educational purposes, people with gaming experience are more focussed on winning the game than learning what the game was designed to teach them, which results in those people learning less than people without gaming experience. By the same logic, as the users of the SBT are not aware of what part of their game play is being measured, the users with computer game experience may strive to complete the tasks in the SBT as quickly as they can without regard for safety behaviour. While this hypothesis is consistence with the findings that participants with computer game experience completed the SBT in a shorter time than the participants with no computer game experience, it is not consistent with the findings that participants with computer game experience have a higher average SBT score than the participants with no computer game experience.

A theory as to why computer game players have better SBT scores than people that do not play computer games is that the SBT is not an entirely novel experience for people with computer game experience. As those participants that reported never having played a computer game before were experiencing computer games for the first time while using the SBT, it may be the case that their true safety behaviour was not able to be measured due to those participants focusing on navigating the test. Conversely, the navigation of the test may have been less effortful for the participants that had played computer games before, and they therefore may have been able better apply their true safety behaviour in the test.

Another hypothesis to explain these findings is that a third variable which was not analysed is causing those people with computer game experience to perform better than those people without computer game experience. In an investigation of personality differences between computer game players and non-computer game players, Teng (2008) found that computer game players had higher scores in openness to experience, conscientiousness, and extraversion than non-computer game players. Interestingly, those same personality traits have long been speculated by researchers to be associated with greater safety behaviour. Geller (2004) suggested that being open to experience would make people more likely to accept and engage in new health and safety related initiatives, while being conscientious would see people being more inherently interested in safety processes, and being extraverted would make it easier for people to use safety procedures that require communication between people. Furthermore, in a meta-analysis of personality traits and accident involvement, Clark and Robertson (2005) found low conscientiousness to be a valid predictor of occupational accident involvement. Given these findings, it may be the case that the higher scores observed in the SBT by those participants with computer game experience compared to those participants without computer game experience is actually the result of a particular set of personality traits that computer game players have that are also associated with safety behaviour, as opposed to the result of the computer game experience directly.

Similarly, it is possible that the impact the computer game experience has on SBT performance may be explained by intelligence. While playing computer games, players are often required to use heuristics, problem solving, abstract thinking, proactive and anticipatory processes, to quickly organise information, and to hold large amounts of information in their memory at one time. Furthermore, success in computer games can sometimes rely on ones literacy and numeracy skills. Given these demands of computer gaming, it would stand to reason that people drawn to playing computer games may have a higher intelligence than people that choose not to play computer games. This idea is supported by the findings of Pillay (2002), who revealed in an investigation of the cognitive processes engaged in by computer players that children who played recreational computer games performed better on subsequent educational tasks than a control group of children that did not play computer games.

Interestingly, higher levels of intelligence have also been shown to be associated with lower rates of accidents. Specifically, the information processing skills of being able to recall relevant information, quickly identify problematic situations, and react quickly to unforeseen situations are said to be key skills in accident prevention (Gottfredson, 2004). Additionally, as discussed in the introduction, Ford and Wiggins (2012) found that those work sites that require employees to have higher cognitive ability have lower injury rates than those work sites with lower cognitive ability requirements, even when controlling for the number of hazards on those work sites. Given these findings, it is possible impact the computer game experience has on SBT performance may be explained by intelligence.

4.0.3 Test Time

It is important when developing a psychometric test to ensure that it is a suitable length. Tests that run too long are said to be associated with response burden, where participants feel strained if they are being tested for too long, or if the test involves too high a cognitive load (Rolstad, Adler, & Rydén, 2011). In this event, participants will begin responding with less effort, or cease responding altogether, thereby threatening the validity of the responses and the subsequent conclusions drawn by the researcher.

Validated psychometric tests used today have a range of durations. Raven's Progressive Matrix takes between 40 and 60 minutes to complete, while the Wesman Personnel Classification Test takes approximately 28 minutes to complete, and the Wonderlic Personnel Classification Test takes approximately 12 minutes to complete (Raven et al., 1985; Wesman, 1965; Wonderlic & Associates, 1983). With an average test time of 17 minutes and 58 seconds, the SBT has a comparatively shorter test time than most other validated psychometric test tools. Additionally, while there were some significant differences between particular groups of participants in regard to the amount of time it took to complete the SBT, none of the groups of participants took an excessively long time to complete the test when considering the duration of other validated psychometric tests. For these reasons, it does not appear that the test time of the SBT reduces the practical use of the test.

4.0.4 Usability

The usability of the SBT is an important factor to consider, as mentioned in section 3.5 of the results section, because it can easily impact the ability of an individual to perform on the SBT, and result in a bias in their scores. If people are not able to understand the test, the real world application of the test and the accuracy of the data gathered by the test will be vastly limited. Based on the mean and the median scores for the five questions regarding SBT usability asked of the participants, it is fair to say that in general the participants found the SBT to be usable. These findings are consistent with the SBT having face validity. Low ratings of usability could easily result if the participants did not see the relevance or application of the test. Thus while the specific question of face validity was not asked – in fact it is impossible to ask using a diverse sample who work in vastly different contexts, the usability results are encouraging in terms of the SBT face validity.

4.1 Practical and Theoretical Implications

These findings, combined with the findings of the study by Crowe (2018) completed in conjunction with the current investigation, suggest that the SBT has potential as a measure of safety behaviour. This outcome has a number of practical and theoretical implications. Firstly, the SBT can go on to be used in selection procedures in organisations to assess the safety behaviour of job applicants. Currently, organisations are limited to using self report or accident histories to assess applicants on their safety behaviour. These methods are both problematic due to the bias associated with self report, and the reliance that assessing accident histories has on the job applicant having had work experience. As the SBT appears to be a valid measure of safety behaviour that requires no self report, and is seemingly able to measure current behaviour as opposed to past behaviour, it may be able to offer a much more reliable way to measure the safety behaviour of prospective employees. Similarly the SBT can be used to assess existing employees in organisations on their safety behaviour. This information can then be used to inform which employees, if any, are exhibiting poor safety behaviour, and may benefit from health and safety training. In both of these instances, the SBT can be used to increase the number of employees in an organisation that engage in safety behaviour, through both hiring employees that behave safely, and allowing existing employees to learn to behave more safely .

Another implication of the findings of the current investigation is that the SBT can be used in research. As discussed, self report data is associated with social desirability bias, meaning that it can be difficult to gather valid findings using self report. Although research using self report is likely to be protected from the social desirability bias because participants will not have anything to gain or lose from responding in a particular way, it would still be preferable to use a method that is not associated with social desirability bias at all when conducting research into safety behaviour. Additionally, while self report in research is somewhat protected from social desirability bias, it can still be vulnerable to impression management, as participants may want to appear more safely behaving to researchers simply to appear like a more responsible person. Having a valid measure of safety behaviour that does not rely on self report may mean that researchers can conduct investigations in to safety behaviour more reliably. With this same logic, the conclusions drawn from such research may be more meaningful, and have a greater impact on how health and safety practices are conducted in New Zealand today and in the future. Altogether, these implications mean that the SBT can be used to reduce the high rate of occupational accidents in New Zealand, and thereby reduce the number of injuries and fatalities experienced by New Zealand employees each year.

4.2 Limitations

One of the major limitations of the current study was the sample size. While 100 participants was a large enough sample to conduct the majority of the analyses planned for the current investigation, there were two analyses that were not able to be undertaken. Specifically, it was initially planned to investigate if having played a point and click game before using the SBT would impact SBT use and performance, and if having a forklift licence would impact SBT use and performance. In regard to both of these analyses, one of the groups that would be compared in the analysis had too few cases to perform a valid comparison between groups, and so the analyses were not conducted. While there were measures of other aspects of both computer game experience and forklift use experience that did have enough cases to be analysed, it is possible that the two analyses that were not able to be performed would have revealed important findings.

Another potential limitation of the current investigation is that more individual characteristics were not measured. As discussed, of all of the individual characteristics measured in the current investigation, computer game experience is the only one that appears to potentially have an adverse impact on SBT performance. However, this finding does not mean that there are not potentially other individual characteristic that have an adverse impact on SBT performance. Again, as discussed, is possible that the impact being shown of computer game experience on SBT performance is actually the result of a third variable that was not measured. Given findings in the literature, it may be the case that that third variable is the personality trait of openness to experience, conscientiousness, or extraversion. Furthermore, literature also supports the idea that the third variable could be intelligence. If personality characteristics and intelligence had been measured in the current investigation, it would be possible to examine whether or not these hypotheses are supported.

4.3 Future research

It may be useful to adjust the SBT after what has been learned from the current investigation. After completing the SBT, participants were given an opportunity in the *individual characteristics questionnaire* to make any comments they may have had regarding the SBT and its use. Of the 26 constructive comments that were made, 14 made suggestions as to aspects of the game that should be modified, 9 indicated that the instructions needed to be made clearer, and the remaining comments related to the individual's experience of the game as opposed to changes that could be made.

While having comments made that suggest the SBT instructions needed to be clearer conflicts with the findings that participants generally rated the SBT as having understandable instructions, the small number of comments made regarding clarify instructions are likely made by the participants that rated the SBT low on having understandable instructions. Although this means that having these comments does not mean that the SBT instructions were not understandable, it does indicate that some changes can be made to further clarify the instructions. Arguably, if the instructions and the other aspects of the game that were commented on by participants were adjusted to be made clearer to the user, the SBT may reveal even greater results in terms of its ability to predict safety behaviour. Therefore, it may be useful to reassess the validity of the SBT after adjustments have been made based on the comments of participants in the current investigation.

As discussed, at this stage it is unknown why computer game experience is associated with significantly different scores on the SBT. Research looking into the relationship between computer game experience and SBT performance would therefore be beneficial to future use of the SBT. Specifically, it may be useful to conduct research into the impact that personality traits may have on SBT performance. This research may reveal not only if personality traits have an impact on SBT performance, but also may reveal if the relationship observed between computer game experience and SBT performance is the result of the personality traits associated with both computer game experience and safety behaviour. Similarly, it may be useful to investigate if intelligence has an impact on SBT performance, which may also have implications for the relationship observed between computer game experience and SBT performance.

4.4 Conclusion

The aim of the current investigation was to determine whether a person's individual characteristics have an identifiable impact on their use and performance on a new measure of safety behaviour – the SBT. Of all of the individual characteristics measured, the results indicate that only a person's computer game experience appears to impact their SBT performance, in that people who have played computer games before tend to perform better on the SBT than people who have not played computer games before. While this finding informed controlling for computer game experience in Crowe's (2018) study of the criterion related validity of the SBT, future research should be conducted to investigate if this relationship is actually the result of personality traits or the intelligence possessed by computer game players, or by something else altogether. Overall, this study indicates that the SBT could benefit organisations by providing a measure of safety behaviour that does not rely of self report or accident history, thus potentially reducing occupational injuries and fatalities in the workplace.

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Appendix A

Individual Characteristics Questionnaire

Code:_________

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Demographic Questions

- Age:……….
- Gender:……….

Computer Game Experience

- Have you played a computer game before using the CPT?

  ☐ Yes ☐ No (please go to "forklift use experience" questions)

- Please indicate how many years and months you have been playing computer games.

  ……….Years and……….months

- Have you ever played a point and click game?

  ☐ Yes ☐ No ☐ Don't know

- How often do you play computer games?

  ☐ Daily ☐ Once every 6 months
  ☐ Weekly ☐ Once a year
  ☐ Monthly ☐ Less than once a year

Forklift use experience

- Have you ever driven a forklift?

  ☐ Yes ☐ No (please go to “work experience” questions)

- Do you have a forklift licence?

  ☐ Yes ☐ No

- Please indicate how many years and months you have had a forklift licence for.

  ……….Years and……….Months

- How many jobs have you worked in that have required you to use a forklift? ………

- Please indicate how many years and months you have worked in jobs that have required you to use a forklift.

  ……….Years and……….months

- How many hours of forklift training have you had?..........

Work Experience

- Do you work full time or part time? Full time □ Part time □

- Please indicate how many years and months you have had your current job for.

  ……….Years and……….months

- How many co-workers do you currently have?..........

- In total, how many different jobs have you had?..........

- Please indicate how many years and months you have worked for, in total.

  ……….Years and……….months

- How many different organisations have you worked for?..........

Accidents and Incidents

- For each of the three accident and incidents categories please indicate the number you have had in each of the three locations: at work, at home, other.

Accident/Incident Category	At work	At home	Other location (e.g. while on holiday, recreating)
Near miss incidents, which could have resulted in injury or damage			
Minor injury requiring medical attention (e.g. first aid treatment or a visit to a doctor)			
Lost Time Injury (LTI) that has required time off work			

Perceived Job Safety Risk

Please indicate the safety risk associated with your current job by placing a mark on this 100 point scale.

0.....10…..20…..30…..40…..50…..60…..70…..80…..90…..100

Not at all Risky Extremely Risky

Health and Safety Training

- Have you completed any health and safety training?

☐ Yes ☐ No (please go to "CPT Usability" questions)

- How many different training programmes related to health and safety have you completed?.............

- How many hours of training related to health and safety have you completed?……….

CPT (Compliance and Participation Test) Usability: The following questions are about your experience with the test you just completed.

- How understandable were the instructions given to you to use the CPT (please circle a number)?

  1……….2………..3………..4………..5……….6………..7

  Not at all Completely

- How easy was it to control the forklift in the CPT (please circle a number)?

  1……….2………..3………..4………..5……….6………..7

  Very Hard Very Easy

- How appropriate was the speed that the forklift moved in the CPT?

  1……….2………..3………..4………..5……….6………..7

  Very Inappropriate Very Appropriate

- Overall, how easy was it to complete the CPT?

  1……….2………..3………..4………..5……….6………..7

  Very Hard Very Easy

- How much did you enjoy completing the CPT

  1……….2………..3………..4………..5……….6………..7

  Not at all Completely

- Do you have any other comments in regard to using the CPT (please write below)?

____

____

____

Safety Participation and Compliance

Listed below are a number of statements that could be used to describe your safety behaviour. Please circle a number to indicate how much you agree or disagree with each statement.

	Never	Rarely	Occasionally	Frequently	Always
I use all the necessary safety equipment to do my job	1	2	3	4	5
I use the correct safety procedures for carrying out my job	1	2	3	4	5
I ensure the highest levels of safety when I carry out my job	1	2	3	4	5
I promote the safety program within the organisation	1	2	3	4	5
I put in extra effort to improve the safety of the workplace	1	2	3	4	5
I voluntarily carry out tasks or activities that help to improve workplace health and safety	1	2	3	4	5

Rule bending

Listed below are a number of statements that could be used to describe your safety behaviour. Please circle a number to indicate how much you agree or disagree with each statement.

	Never	Rarely	Occasionally	Frequently	Always
I cut corners if it makes the task easier	1	2	3	4	5
Work pressures mean that I bend safety rules	1	2	3	4	5
I bend the rules when I know it is safe to do so	1	2	3	4	5
When my boss is not around I can be more flexible with which procedures I follow	1	2	3	4	5

Safety Voicing

Listed below are a number of statements that could be used to describe your safety behaviour. Please circle a number to indicate how much you agree or disagree with each statement.

	Never	Rarely	Occasionally	Frequently	Always
I make suggestions about how safety could be improved	1	2	3	4	5
I tell colleagues who are doing something unsafe to stop	1	2	3	4	5
I discuss new ways to improve safety with my colleagues or boss	1	2	3	4	5
I inform the boss when I noticed a potential hazard	1	2	3	4	5
I report to my boss if my colleagues break any safety rules	1	2	3	4	5

Safety Consciousness and Risk Taking

Listed below are a number of statements that could be used to describe your safety behaviour. Please circle a number to indicate how much you agree or disagree with each statement.

	Strongly disagree	Disagree	Neither agree/disagree	Agree	Strongly Agree
I always take extra time to do things safely	1	2	3	4	5
People think of me as being an extremely safety-minded person	1	2	3	4	5
I always avoid dangerous situations	1	2	3	4	5
I take a lot of time to something safely even when it slows my performance	1	2	3	4	5
I often find myself making sure that other people do things that are safe and healthy	1	2	3	4	5
I get upset when I see other people acting dangerously	1	2	3	4	5
Doing the safest possible thing is always the best thing	1	2	3	4	5
I would rather take risks than be overly cautious	1	2	3	4	5
In the past month I have done some exciting things that other people might think are dangerous	1	2	3	4	5
I love to take risks even when there is a small chance I could get hurt	1	2	3	4	5
Sometimes people get on my nerves when they tell me how to act "more safely"	1	2	3	4	5
I value having fun more than being safe	1	2	3	4	5

Please check that you have answered all questions.

Thank you for taking the time to participate in this research.

Appendix B

Acquaintance Questionnaire

Code: _______________

General questions about you:

Your Age _____

Your Gender: _______________

How long have you known *… for? Years _____ Months_____

How do you know *… ? (tick as many categories as necessary)

I am *…'s
- Work colleague □
- Work manager□
- Worker supervisor□
- Spouse □
- Child □
- Parent □
- Friend □
- Sport/Recreation associate□
- Partner □
- Other □ (please specify_____________________________)

Please indicate how well you know *…. by placing a mark on the 100 point scale.

0.....10…..20…..30…..40…..50…..60…..70…..80…..90…..100

Not Very Well At All — Extremely Well

Questions about *…:

Rated safety risk score

Considering *…'s behaviour in all the situations that you know, please indicate *…'s general degree of safety risk by placing a mark on the 100 point scale.

0.....10…..20…..30…..40…..50…..60…..70…..80…..90…..100

Not at all Risky — Extremely Risky

For each of the three accident and incidents categories please indicate the number you know *… has had in each of the three locations: at work, at home, in any other location. If you feel you don't know please tick in the 'don't know' column

Accident/incident Category	At work	At home	Other Location (e.g., while on holiday, recreating)	Don't Know
Near miss incident, which could have resulted in injury or damage				
M**inor injury** requiring medical attention (e.g. first aid treatment or a visit to a doctor)				
Lost Time Injury (LTI) that has required time off work				

Safety Compliance and Participation

These statements are about how *… behaves. For each statement, please circle the number which indicates the extent to which you disagree or agree. If you don't know about an item please tick in the 'don't know' column.

	Strongly Disagree	Disagree	Neither Agree/ Disagree	Agree	Strongly Agree	Don't Know
*… makes suggestions about how safety could be improved	1	2	3	4	5	
*… tells others who are doing something unsafe to stop	1	2	3	4	5	
*… discuss new ways to improve safety with his/her colleagues or boss	1	2	3	4	5	
*… informs the boss when he/she notices a potential hazard	1	2	3	4	5	
*… reports to his/her boss if their colleagues break any safety rules	1	2	3	4	5	

Safety Voicing and Rule Bending

Listed below are a number of statements that could be used to describe *…'s safety behaviour. Please circle a number to indicate how much you agree or disagree with each statement. If you don't know about any item please tick in the 'don't know' column.

	Strongly Disagree	Disagree	Neither Agree/ Disagree	Agree	Strongly Agree	Don't Know
*… always uses all the necessary safety equipment to do their job	1	2	3	4	5	
*… always uses the correct safety procedures to carry out their job	1	2	3	4	5	
*… always ensures the highest level of safety to carry out their job	1	2	3	4	5	
*…. promotes the safety programme within their organisation	1	2	3	4	5	
*… puts in extra effort to improve the safety of their workplace	1	2	3	4	5	
*… voluntarily carries out tasks or activities that help to improve workplace safety	1	2	3	4	5	
*… sometimes cuts corners if it makes the task easier	1	2	3	4	5	
Work pressures means that *… sometimes bends the rules	1	2	3	4	5	
Occasionally*….bends the rules when he/she knows it is safe to do so	1	2	3	4	5	
When *…'s boss is not around he/she can be more flexible with which procedures he/she follows	1	2	3	4	5	

Safety Consciousness and Risk Taking

These statements are about how *… behaves. For each statement, please circle the number which indicates the extent to which you disagree or agree. If you don't know about an item please tick in the 'don't know' column.

	Strongly Disagree	Disagree	Neither Agree/ Disagree	Agree	Strongly Agree	Don't Know
*… always takes extra time to do things safely	1	2	3	4	5	
People think of *… as being an extremely safety-minded person	1	2	3	4	5	
*… always avoids dangerous situations	1	2	3	4	5	
*… takes a lot of time to do things safely even when it slows their performance	1	2	3	4	5	
*… often makes sure that other people do things that are safe and healthy	1	2	3	4	5	
*… gets upset when seeing other people acting dangerously	1	2	3	4	5	
*… thinks doing the safest possible thing is always the best thing	1	2	3	4	5	
*… would rather take risks than be overly cautious	1	2	3	4	5	
In the past month *… has done some exciting things that other people might think are dangerous	1	2	3	4	5	
*… loves to take risks even when there is a small chance he/she could get hurt	1	2	3	4	5	
Sometimes people get on *… nerves when they tell him/her how to act "more safely"	1	2	3	4	5	
*… values having fun more than being safe	1	2	3	4	5	

Appendix C

Email Template

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Dear **insert company name*

My name is Kristy Thomas, and I am completing my Masters at the University of Canterbury. As part of my research, I am validating a new test of employee safety behaviour called the CPT. The CPT (safety compliance and participation test) is gamified test, meaning that people interact with an environment on a computer as a way of being tested. Hopefully the test can be used in organisations to inform which employees require health and safety training, and in the selection process to identify applicants who will behave safely in a work environment.

My Maters research is seeking to validate the CPT. Validation is a three stage process, where participants must first complete the CPT, then fill out a questionnaire regarding their own safety behaviour, and finally have a colleague/acquaintance/supervisor fill out a questionnaire regarding the participant's safety behaviour. In exchange, a $10 petrol voucher will be given to both the participant and the colleague/ acquaintance /supervisor. The process requires about 30 minutes of time from the participant, and about 10 minutes of time from the colleague/ acquaintance/supervisor. To complete the study I could work at your organization, and would require a quiet office space and an internet connection.

At the end of the study, if the CPT is shown to be a valid measure of safety behaviour, I will be able to provide your organisation with aggregated information on how your employees did on the test. While I am unable to give you data for individual employees, I can give you a distribution of their scores.

Thank you very much for considering being part of my study. I would be happy to meet and demonstrate the CPT, and discuss the project further.

For more information, please contact me at kth63@uclive.ac.nz.

Kind regards,

Kristy Thomas

Appendix D

Participant Advertisement

Participants Wanted!

Would you like to take part in a study that investigates using a computer game as a new measure of safety behaviour?

I am conducting a study that aims to validate a computer game as a new measure of safety behaviour.

Participants will be required to play the computer game (which will take approximately 20 minutes), complete a questionnaire (which will take approximately 10 minutes), and find an acquaintance to complete a questionnaire as well (which will take them approximately 10 minutes). An example of someone who may be an acquaintance for the purpose of this research may be a family member, a friend, or a sport or recreation associate.

The participant and their acquaintance will each receive a $10 petrol voucher after completing their tasks.

Participants are required to have adequate eye sight for playing a computer game, and to be currently working either full time or part time.

If you are interested, please tear off an email address and contact me!

Email: kth63@uclive.ac.nz
Email: kth63@uclive.ac.nz
Email: kth63@uclive.ac.nz
Email: kth63@uclive.ac.nz
Email: kth63@uclive.ac.nz
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Appendix E

Participant Information Sheet

Department of Psychology
Email: kth63@uclive.ac.nz

05/04/2017

Validation of the CPT: The Impact of Individual Characteristics on CPT Participant Information Sheet

I am Kristy Thomas, and I am a Masters student in the Department of Psychology at the University of Canterbury. The purpose of this research is to validate the safety *Compliance and Participation Test* (CPT) as a measure of safety behaviour. The CPT is a fully animated computer game. The players must point the cursor at areas on the screen and click in order to interact with the game environment. In the CPT, players will be given instructions to retrieve several different items from within a warehouse using a forklift, and then load each item into a container. In order to validate the CPT, the current study will require participants to complete both the CPT, and an individual characteristics questionnaire. The results of the questionnaire will be used to determine if any individual characteristics have an identifiable impact on CPT use and performance.

If you choose to take part in this study, your involvement in this project will be to complete the CPT, and to complete a questionnaire that assesses individual characteristics and safety behaviour. The CPT and the questionnaire will each take approximately 20 minutes to complete. You will also be required to invite one of your acquaintances to participant in the study. Your acquaintance can be a work colleague, friend, family member, or sports and recreation associate for example, and must be close enough to you to be able to report on your safety behaviour in general and at work. You will be required to take an envelope to the acquaintance you have chosen, which will contain an information sheet, a consent form for them to sign, a questionnaire for them to complete that assesses your safety behaviour, and a $10 petrol voucher for your acquaintance.

Participation is voluntary and you have the right to withdraw at any stage without penalty. You may ask for your raw data to be returned to you or destroyed at any point. If you withdraw, I will remove information relating to you. However, once analysis of raw data starts on the *1st October 2017*, it will become increasingly difficult to remove the influence of your data on the results.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity will not be made public without your prior consent. To ensure confidentiality, you will be allocated a code that will be written on your CPT score, your questionnaire, and your acquaintance's questionnaire as opposed to your name. Furthermore, all physical data will be stored in a locked filing cabinet in a locked room, while all electronic data will be stored in a password protected computer in a locked room, and no person outside of the research team will have access to data. A thesis is a public document and will be available through the UCLibrary. Data will be destroyed after five years, unless a publication outlet requires extended archiving of the data.

Please indicate to the researcher on the consent form if you would like to receive a copy of the summary of results of the project.

The project is being carried out in partial fulfilment of the requirements for the degree of Master of Science in Applied Psychology at the University of Canterbury by Kristy Thomas under the supervision of Associate Professor Christopher Burt, who can be contacted at christopher.burt@canterbury.ac.nz. He will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form and return to the researcher.

Appendix F

Participant Consent Form

Department of Psychology
Email: kth63@uclive.ac.nz
05/04/2017

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Validation of The CPT: The Impact of Individual Characteristics on CPT Use.
CPT Participant Consent Form

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ☐ I understand that any information or opinions I provide will be kept confidential to the researcher and supervisor of the research and that any published or reported results will not identify the participants or organisation. I understand that a thesis is a public document and will be available through the UC Library.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after five years, unless a publication outlet requires extended archiving of the data.
- ☐ I understand that there are no risks associated with taking part in this study
- ☐ I understand that I can contact the researcher, Kristy Thomas (kth63@uclive.ac.nz) or supervisor Christopher Burt (christopher.burt@canterbury.ac.nz) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800,Christchurch (human-ethics@canterbury.ac.nz)
- ☐ I would like a summary of the results of the project.
- ☐ By signing below, I agree to participate in this research project.

Name:____________________________Signed:__________________________Date:_______________

Email address *(for report of findings, if applicable)*:____

Appendix G

Acquaintance Information Sheet

Department of Applied Psychology
Email: lydia.crowe@pg.canterbury.ac.nz
Date: 04.04.2017

Validation of the Compliance and Participation Test: Criteria Validity Evidence

Acquaintance Information Sheet

I'm Lydia Crowe and I am a Masters of Applied Psychology student at the University of Canterbury conducting a study of the validity of the *Compliance Participation Test (CPT)*. The purpose of the research is to establish if the CPT is a valid measure of safety compliance and participation.

If you choose to take part in this study, your involvement in this project will be to spend approximately 10minutes completing an acquaintance questionnaire. This questionnaire includes several safety behaviour items about *…………………………who consented to you completing this questionnaire. Whenever you see *… below this refers to the person who invited you to participate in this study. After completing this questionnaire, the questionnaire itself and the completed consent form should be sealed in the provided envelope and given back to the demonstrator who will bring it back to University of Canterbury Psychology Department and collect a $10 petrol voucher for your participation in this study.

Participation is voluntary and you have the right to withdraw at any stage without penalty. You may ask for your raw data to be returned to you or destroyed at any point. If you withdraw, I will remove information provided by you. However, once analysis of raw data starts on the 1st October 2017, it will become increasingly difficult to remove the influence of your data on the results.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity will not be made public without your prior consent. To ensure confidentiality the consent form and questionnaire will be kept in the sealed envelope until its arrival at the University of Canterbury Psychology Department. When on opening the two documents will be immediately separated to maintain confidentiality. Your name will not be collected on any document other than the separate consent form. Instead the Acquaintance Questionnaire will be coded with the same code as *….No one other than me (as the researcher) and Chris

Burt(as the research supervisor) will have access to the data. Physical data will be stored in a locked filing cabinet in a locked room. Electronic data will be stored on a password protected computer, in a locked room. Data will be destroyed after 5 years, unless a publication outlet requires extended archiving of the data. A thesis is a public document and the subsequent thesis will be available through the UC Library. Please indicate on the consent form if you would like to receive a copy of the summary of results of the project.

The project is being carried out as a requirement for the Masters of Applied Psychology programme by Lydia Crowe under the supervision of Chris Burt, who can be contacted at christopher.burt@canterbury.ac.nz. He will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and on approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch(human-ethics@canterbury.ac.nz). The study's reference number is HEC 2017/26.

If you agree to participate in the study, you are asked to complete the consent form before completing the acquaintance questionnaire.

Appendix H

Acquaintance Consent Form

Department of Applied Psychology
Email: lydia.crowe@pg.canterbury.ac.nz
Date: 04.04.2017

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Validation of the Compliance and Participation Test: Criteria Validity Evidence
Acquaintance Consent Form

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ☐ I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after five years, unless a publication outlet requires extended archiving of the data.
- ☐ I understand there are no risks associated with taking part in this study
- ☐ I understand that I can contact the researcher [*Lydia Crowe* lydia.crowe@pg.canterbury.ac.nz] or supervisor [*Chris Burt*christopher.burt@canterbury.ac.nz] for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800,Christchurch (human-ethics@canterbury.ac.nz)
- ☐ I would like a summary of the results of the project.
- ☐ By signing below, I agree to participate in this research project.

Name:___________________________Signed:__________________________Date_____

Email address *(for report of findings, if applicable)*:_______________________________________

Appendix I

Summary of Results from Crowe (2018)